DESIGN, CONSTRUCTION, OPERATION OF METAL-WORKING AND ALLIED EQUIPMENT

MACHINERY

JULY, 1945

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Military vehicles in the early days of the war were provided with either coil or volute spring suspensions, the exposed springs of which were especially vulnerable to enemy shell fire. This vulnerability was eliminated in the construction of the Hellcat destroyers by the use of springs that consisted of torsion bars which extend crosswise under the floor of the vehicle, adequately protected from damage. Because of the satisfactory performance of springs of this type on tank destroyers and other military vehicles, it is likely that they will be used on post-war motor trucks. Many readers of August MACHINERY, therefore, will be especially interested in the leading article, which will describe major operations in the production of torsion-bar springs.

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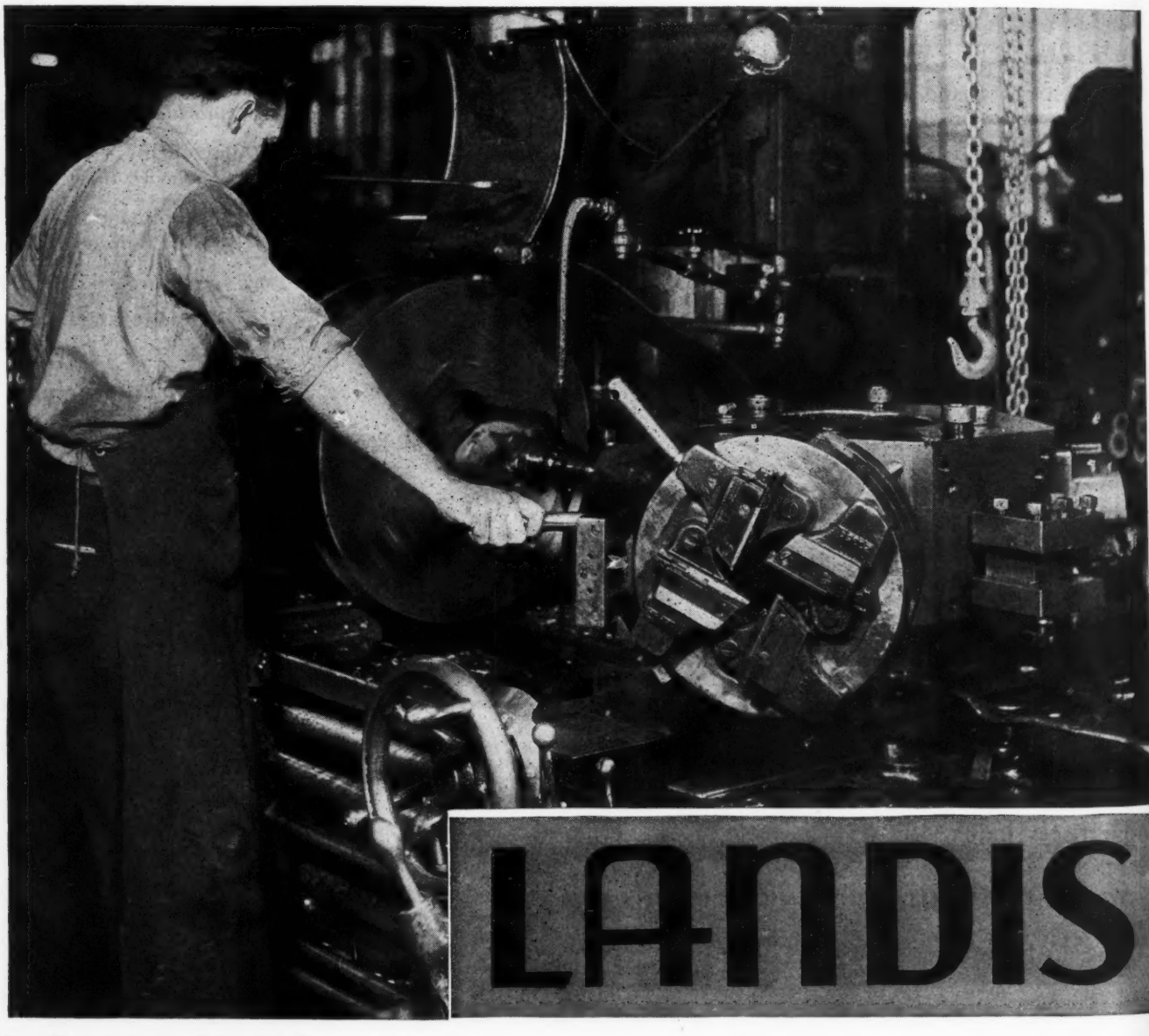


LANDIS

Extrusion of Aluminum Parts for Douglas Aircraft

Remarkable Results Obtained on Standard Punch Presses Point Toward Wide Manufacturing Economies in Various Industries

By J. R. BOSTON, Tooling Division
Douglas Aircraft Co., Inc., Santa Monica, Calif.

COLD impact extrusion—the forcing of metal under high pressure through an aperture of different size and contour than the cold metal blank, thereby creating sufficient heat in the metal to bring it into a plastic state and make it flow—has long been used for the manufacture of collapsible tubes from lead, tin, zinc, and other soft metals. Some months ago, engineers of the Douglas Aircraft Co., Inc., decided that if this process could be successfully applied for the production of parts from aluminum, untold economies could be achieved, as it would be possible in many cases to produce in a single operation parts that require as many as four or five operations when drawn from sheet aluminum. Also, certain parts could doubtless be extruded that cannot be drawn.

Extensive research has brought practical results. A considerable number of parts have been successfully extruded on an experimental basis, and a limited number are now being manufactured on an actual production basis. All operations are performed on standard punch presses. The successful application of the practice suggests possible revolutionary changes in certain shop methods in the aircraft and other industries.

Typical examples of work so far produced are shown in Figs. 1 and 2. As an indication of size, it may be mentioned that the part of rectangular cross-section at the upper right in Fig. 1 is approximately 3 inches long by 1 3/8 inches wide by 3 3/4 inches high. Half of such a part is shown at the extreme right, and in front of the cup-shaped part in the top center, there is half of a similar part.

Somewhat smaller parts extruded from aluminum are seen in Fig. 2. The very small pieces, which are closed at one end and open at the other, have a wall thickness of only 0.003 inch. They are 5/32 inch in inside diameter by 1/2 inch long. The flanged parts seen in this illustration, and also those in Fig. 1, have a hole extending from end to end.

Aluminum parts can be cold impact extruded within dimensional tolerances as close as plus or minus 0.001 inch, although the practice is to observe a tolerance of plus or minus 0.002 inch. It will be obvious that both symmetrical and unsymmetrical parts can be extruded. Different wall thicknesses can be obtained by simply changing the shut height of dies or the dimensions of the die cavity. It is possible to extrude a part to a height six times the blank thickness.

The parts should preferably be extruded from 2S-O, 3S-O, or 61S-O aluminum alloy. It is possible to extrude 24S-O aluminum alloy if the material is heated to a temperature of from 200 to 600 degrees F., but the results have not been consistently satisfactory. Magnesium can also be impact extruded if first heated to a temperature of approximately 700 to 800 degrees F. Another advantage of cold impact extrusion is that parts can be made with sharp corners as easily as with round corners.

As an indication of the economies effected by this process, it may be mentioned that torque tube collars similar in appearance to the flanged tubular parts at the left in Fig. 1, cost $3.37 per piece when produced in lots of 600 from sheet aluminum alloy on regular punch press dies. Eight operations were required. The same part costs only $1.78 per piece when produced in lots

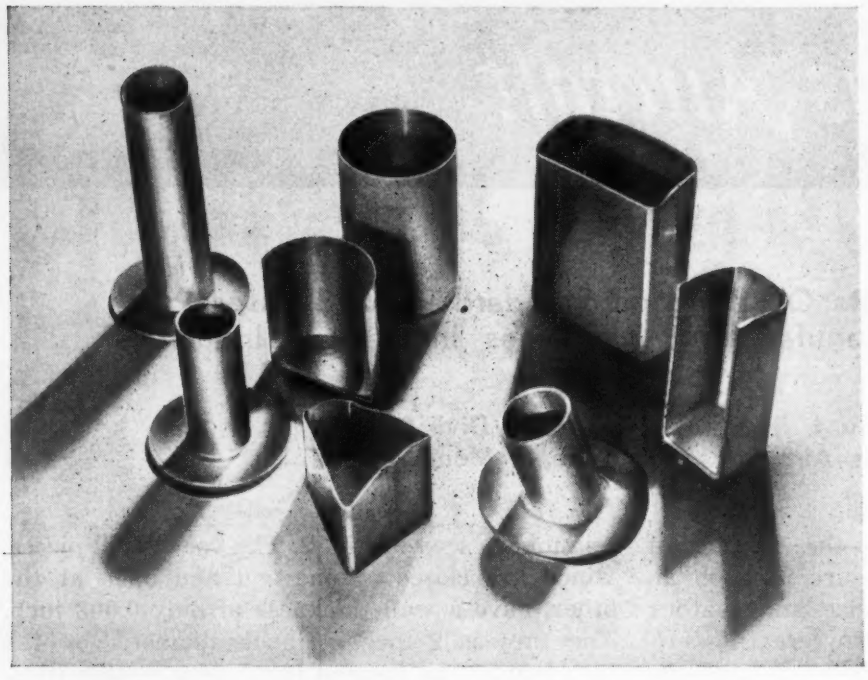


Fig. 1. A Variety of Parts that have been Cold Impact Extruded from Aluminum with One Stroke of Standard Punch Presses

of 600 by impact extrusion. The part is 2 1/8 inches long, 2 1/4 inches in outside diameter, and has a flange 3 15/16 inches in diameter.

Two general types of impact extrusion dies have been developed by Douglas engineers. Both types have one thing in common in that when the punch hits the metal the latter flows along the punch. In the case of the Hooker process die, this flow of the metal occurs in the direction of the punch movement, as indicated at *A*, Fig. 3, there being an opening in the die that permits the extruded metal to extend downward.

Regular impact extrusion dies are made with a blind bottom, as seen at *B*, Fig. 3, so that the metal flows up along the punch in the opposite direction to the punch movement. Since the extruded metal is not confined within the die, the smoothness of the outside surface obtained on the parts seems almost phenomenal. Figs. 5 and 6, which are close-up views of the heading illustration, show two stages in the extrusion of a typical part. In Fig. 5, the part has been extruded for about one-half its length, and in Fig. 6, the operation has been completed.

Hooker dies can be made of a progressive type in which the material is first blanked out from strip stock and possibly pierced, and then extruded in a second station. The small circular flanged pieces seen in Fig. 2, as well as the smaller cup-shaped parts, are made in dies of the progressive type. Less difficulties have been encountered with Hooker dies than with the regular type. This is due to several reasons. First, a true alignment of the punch and die at all times is assured. Then, too, the short sturdy punch construction possible because of the fact that the punch length is practically independent of the part length, reduces working problems.

Another advantage of Hooker dies is that parts with fillets can be more readily produced with this type of die than with the regular type. When rounded punches are used with regular impact dies, there is a tendency to forge the metal into shape without creating enough heat to bring it into the plastic condition necessary for extrusion. Increased compressive force is therefore required with the regular type for the production of rounded parts.

Also, on the regular type of impact extrusion die, the punch is not as well supported sidewise, and is sometimes so affected by the pressure of the metal flow that noticeable variations occur in the wall thickness of the work-pieces. To overcome these defects of regular dies, a four-post universal die set was designed. This die set, which is seen on the press in the heading illustration and also in Figs. 5 and 6, insures true alignment of punches and dies of the regular type and provides adequate punch support. It also lowers die costs and facilitates set-ups.

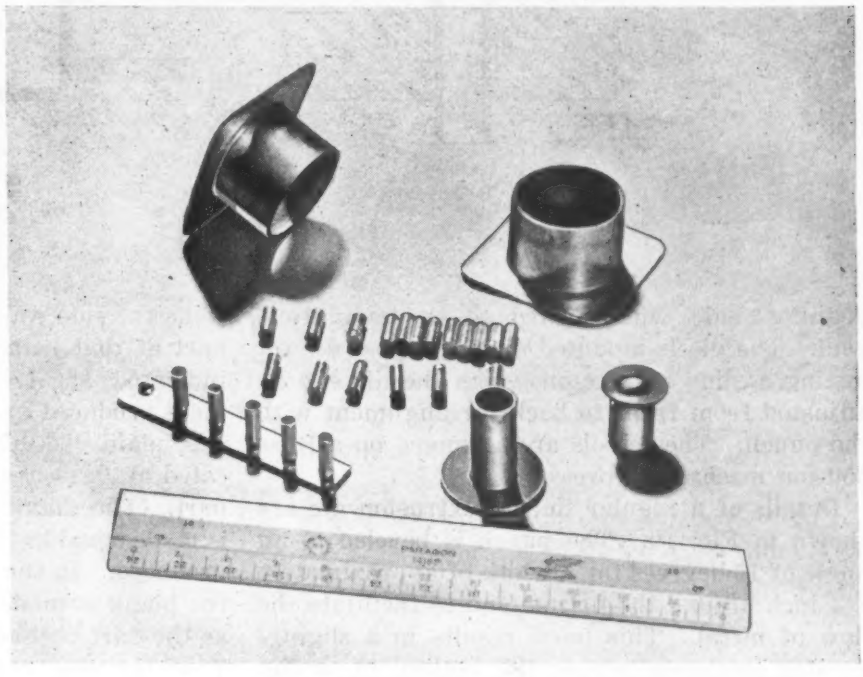


Fig. 2. Group of Smaller Parts Extruded from Aluminum Alloy, the Very Small Cups having a Wall Thickness of Only 0.003 Inch

In Fig. 4, this universal die set is illustrated in perspective. It is made of S A E 1020 hot-rolled steel. The die set is constructed for alignment of a punch with its die cavity within 0.001 inch in all directions. The shank spacer of the punch-holding member must match the corresponding cavity in the press ram within a similar tolerance as far as height is concerned.

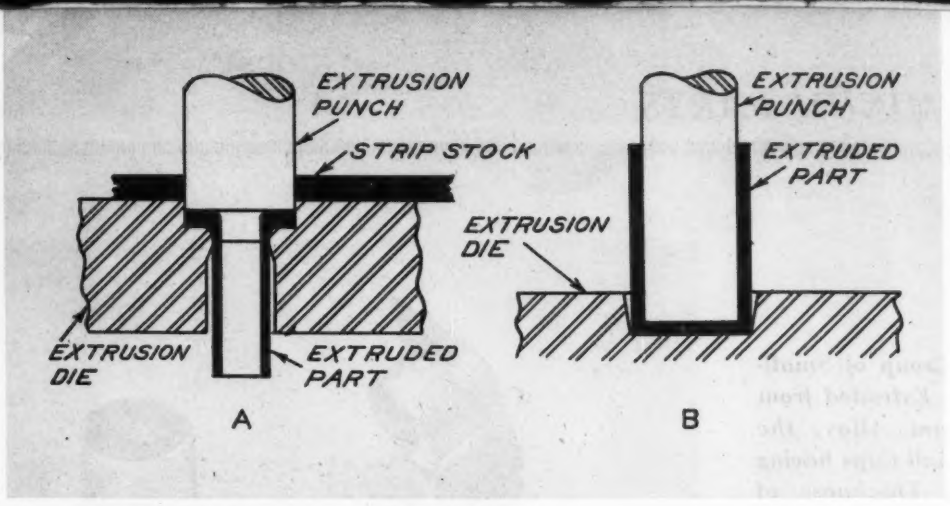
Fig. 7 shows a close-up view of the regular type of impact extrusion die seen in the universal die set in Figs. 5 and 6, together with its punch, a finished part, and the slug or blank from which this part is produced in one stroke. Fig. 8 shows another die and punch designed for use in the four-post die set. The work produced by this punch is of unusual interest, because it is unsymmetrical in shape and has an offset approximately 1/16 inch high on one side. At least four press operations would be necessary to produce this part by drawing. Both the parts in Figs. 7 and 8 are produced on a Bliss mechanical press having a maximum capacity of 900 tons. The guards provided to protect the operators of the presses shown were removed at the time that the photographs were taken.

Punches for the regular impact extrusion dies can be doweled to insure accurate location in the punch-holder of the universal die set, and attached by machine screws. The dies are simply held in place in the shoe by four hold-down clamps after having been properly aligned with adjusting screws. The stripper plate is adjustable for height, as will be apparent from Fig. 4, and can be provided with interchangeable inserts to suit the contour of the various punches. There is a hole in the center of the die shoe of the same size as the pin of the air cushion that is provided on the press. The hole in the center of the punch-holder can be used for a knock-out device when a Hooker die of the inverted type is used in this universal die set.

The shank spacer on top of the punch-holder not only serves as a shank for the holder, but also provides a horizontal support for this member in the press ram. The spacer should completely fill the ram cavity and should extend below the ram surface for at least 0.001 inch. A dummy part can be used for lining up the punch and die for an odd-shaped piece, but a standard feeler gage should always be on hand.

Extra long pressure pins must be used outside of the die for lowering the knock-out device when the ram descends, in order to insure that there will be no interference from this device during extrusion. The pressure pins should also be adjustable to suit various die shut heights.

In Fig. 9 is seen a die designed for producing a part approximately 3/4 inch in diameter by 1 1/2 inches long, having a closed bottom about 1/16 inch from one end. This bottom is at a



definite angle with regard to the cylindrical wall. The die is mounted on a two-post die set having a slide surface on which the die can be adjusted from front to back for alignment with the punch. These tools are arranged on a Bliss 350-ton mechanical press.

Details of a regular impact extrusion die are shown in Fig. 10. The punch is beveled to an angle of 15 degrees for a width of approximately 1/4 inch around the bottom end to facilitate the flow of metal. This bevel results in a slightly greater thickness where the bottom of a cup joins the side wall and promotes strength of the part at that point. This increased thickness is indicated at *A*, which shows the cup-shaped piece produced in a die of the design illustrated.

A plain disk-like slug or blank, such as indicated at *B*, is used in producing the cup-shaped part. The diameter of this slug in most cases is made equal to the outside diameter of the part produced. In the case of parts of other shapes, the blank is made of the same contour and size as the part bottom. To determine the thickness *T* of the slug required for a given part, it is

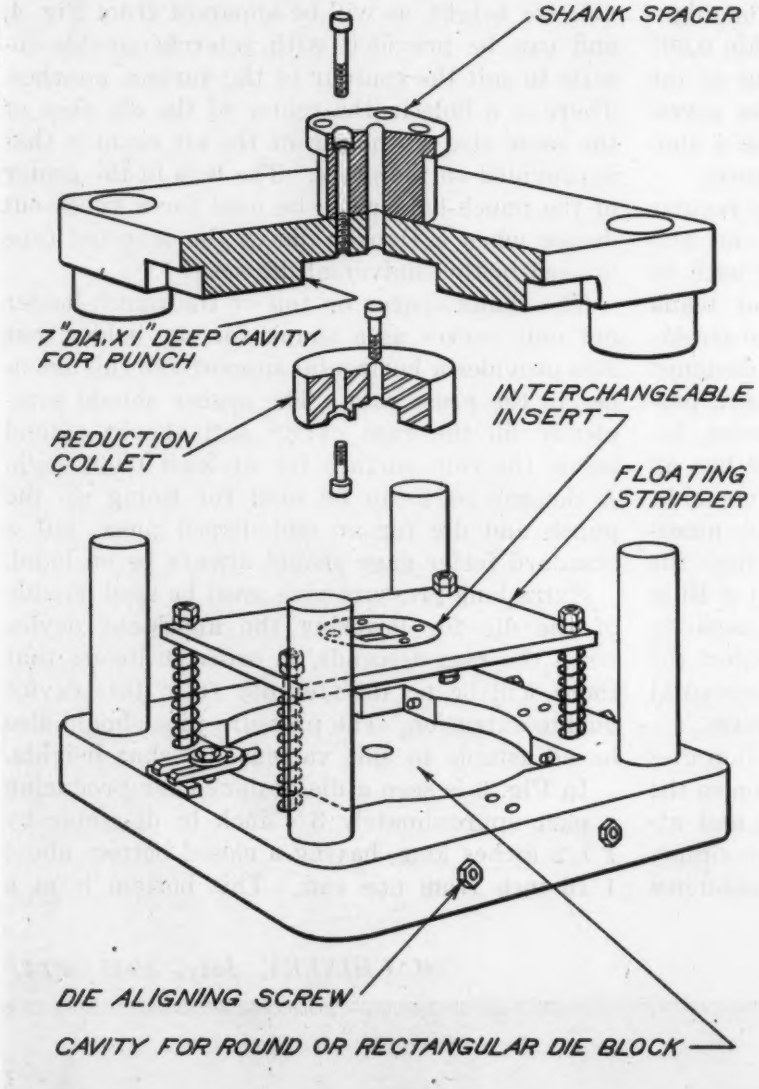


***Fig. 3.** (Above) Diagrams Indicating the Flow of Metal in Cold Impact Extrusion when a Hooker Process Die is Used, as Shown at A, and when a Regular Die is Employed, as Shown at B*

***Fig. 4.** (Left) Four-post Die Set Designed for the Universal Application of Various Hooker Process and Regular Impact Extrusion Dies to Facilitate Correct Alignment of the Punch and Die and Reduce Die Costs*

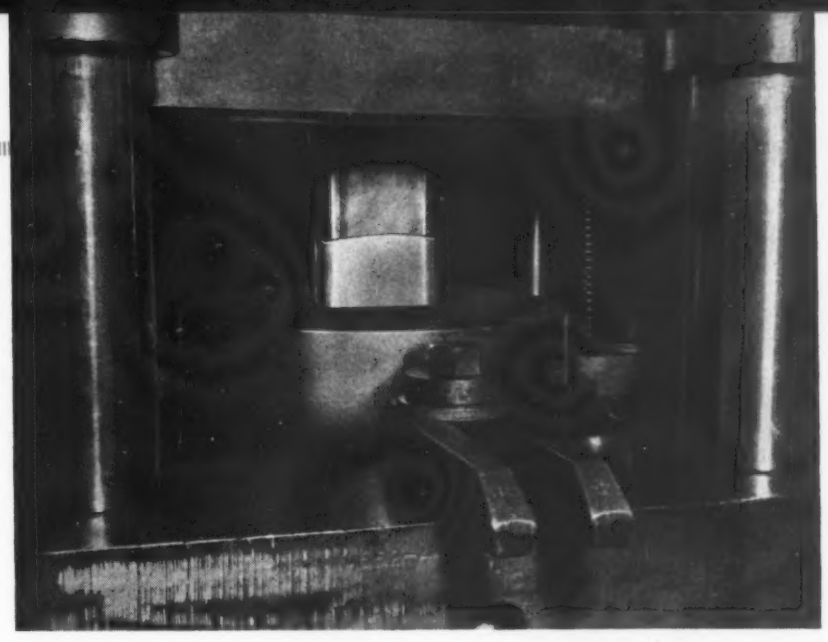


Fig. 5. Extruding a Cup of Rectangular Cross-section from Aluminum Alloy in a Die of the Regular Type Mounted in a Die Set, the Operation being About Half Completed

first necessary to calculate the volume V of the material required in the part and divide this by the bottom area A of the cup. Thus, $T = \frac{V}{A}$. If an allowance must be made for trimming the part, approximately 5 per cent should be added to the thickness.

In calculating the press pressure P required for a given regular impact extrusion die, area A should be multiplied by the compressive strength S of the particular type of aluminum alloy being used. The tonnage thus determined is multiplied by a safety factor f of 2, to insure proper life of the tools and the machine. The formula for calculating the required pressure is, therefore, $P = ASf$.

The diameter N of the die-blocks varies from 2 1/2 inches for a bottom cup area of 1 square inch up to 12 inches for a bottom cup area of 7 square inches. The minimum height H of the die-block should be at least twice the diameter of the blank. The depth of the die cavity D is usually equal to the blank thickness plus 1/8 inch.

Details of a Hooker process impact extrusion die designed for producing a flanged tubular part are shown in Fig. 12. The part for which this die was designed is shown at A and the blank or slug at B. The diameter of the slug should equal the flange diameter of the extruded part, and the diameter of the pierced slug hole should correspond with the hole in the tubular portion of the extruded part.

To determine the thickness T of the blank for such a part, the volume V of material in the part should be divided by area X of the flange. Thus, $T = \frac{V}{X}$. In this case, also, if the part must be trimmed, approximately 5 per cent should be added to the thickness. The press pressure required is determined by multiplying the flange area by the compressive strength S of the particular type of aluminum used, and then multiplying this tonnage by a safety factor f of 2. The formula, therefore, is $P = XSf$.

The diameter N of Hooker process die-blocks is also based on the area of the blank, being,

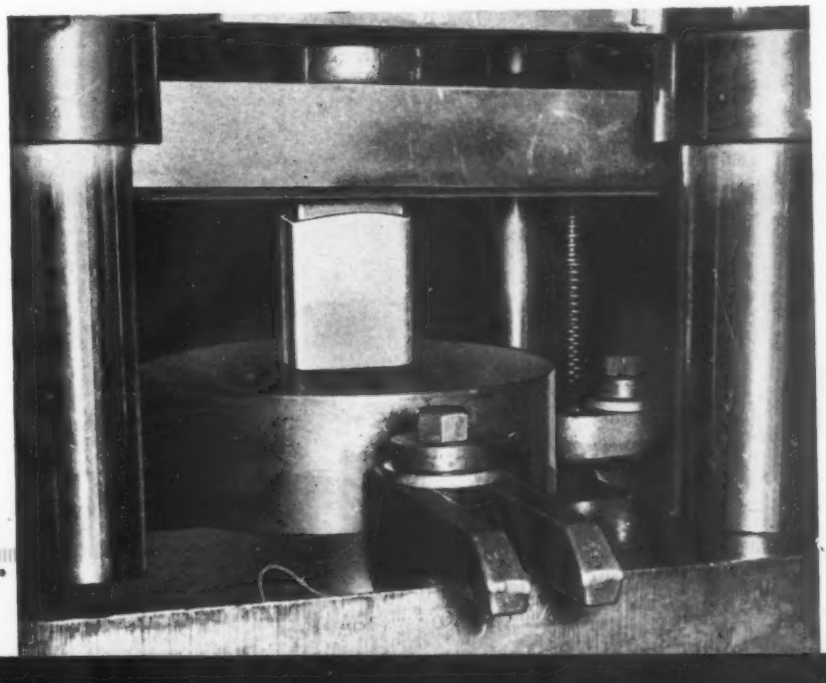


Fig. 6. Another View of the Extruding Operation Shown in Fig. 5, the Photograph having been Taken after the Cup of Rectangular Cross-section had been Completely Extruded

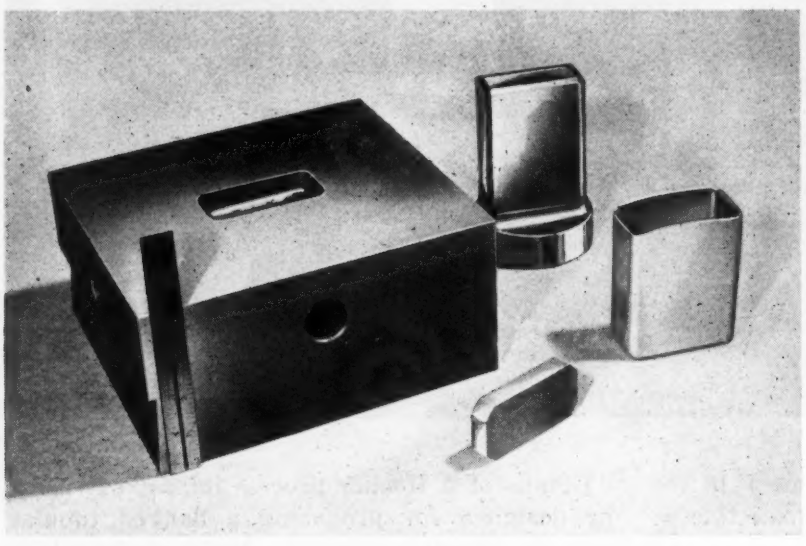


Fig. 7. Cold Impact Extrusion Die and Punch of the Regular Type which are Used to Produce a Rectangular-shaped Cup from the Half-inch Thick Slug or Blank Shown

again, 2 1/2 inches for an area of 1 square inch and 12 inches for an area of 7 square inches. The minimum height *H* of the die-block should be made twice the blank diameter. The depth of the die cavity should be equal to the blank thickness plus 3/16 inch.

On both regular and Hooker dies, the clearance between the punch and the walls of the die cavity should equal the desired wall thickness of the part plus an allowance for the coefficient of expansion of the metal. This allowance should be about 0.013 per cent of the wall thickness.

In order to determine the flow characteristics of metal during extrusion, many tests were conducted on lead and other soft metals, but this investigation proved to be time wasted because of the fact that aluminum alloys react altogether differently from the softer metals. In extruding a simple aluminum-alloy part such as shown by diagram *B*, Fig. 3, from 2S-O or 3S-O material, the metal tries to fill the complete die cavity as it is first compressed. Under the impact, which in Douglas practice amounts to about 45 tons per square inch, the top and bottom surfaces of the metal blank not only work-harden, but also fill up the most minute scratches on the highly polished surfaces of the punch and die. Enough friction is apparently created to momentarily hold the surface skin of the blank. The inside or core metal of the blank is, however, immediately squirted through the die aperture.

That this is true is apparent from the fact

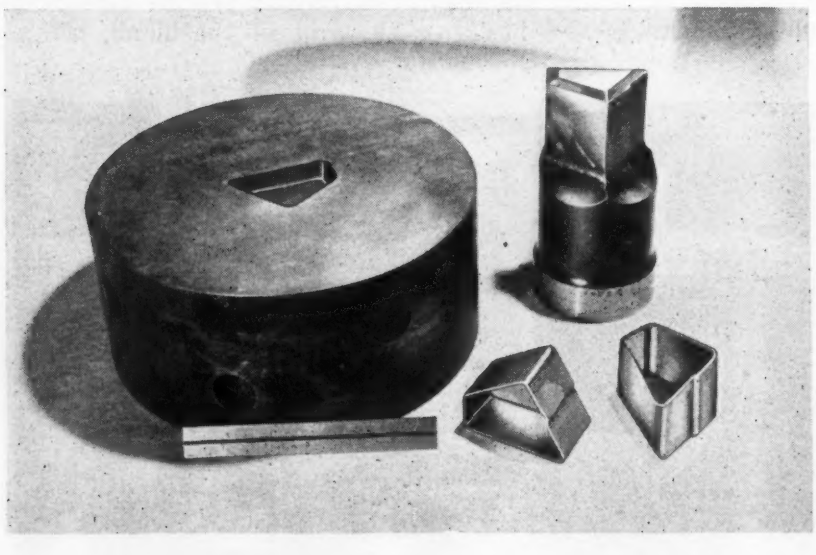


Fig. 8. Another Regular Type Cold Impact Extrusion Punch and Die which Produce an Unsymmetrical Aluminum-alloy Part having a Slight Offset along One Wall

that the core metal and the skin metal can be easily distinguished on extruded parts by their different color and by the denser structure of the skin metal. A pronounced increase in pressure and heat is required to make the skin metal squirt through the die aperture. Sometimes the necessary pressure will break the punch, this being especially true when the wall thickness on the bottom of the part is exceptionally thin.

The skin layer contains oxide and impurities which, if caught in the vortex of the flowing metal, will result in surface defects on the work. These defects are common and troublesome. Sometimes this difficulty can be overcome by not polishing the bottom of either the punch or the die cavity, except for the portions that exert an important influence on the shape of the part or the thickness of the walls. The reduced polishing increases the friction imposed on the skin.

Lubrication of the strip stock or blanks has an important effect on metal flow during impact extrusion. The lubricant should be of a high flash type because of the high temperatures created in the process. Lubricants should be either sparingly used and evenly distributed over the blank or else used in abundance, with provision for the escape of excess oil.

Proper lubrication will decrease the required impact force. The effect of lubricant can easily be noticed by checking the height of extruded parts. With lard oil, for example, a very smooth extruded part will be produced, but due to the high pressure required, the parts may vary in height as much as 1 inch. Also, the metal will take advantage of the slightest irregularity in punch and die alignment, and may squirt on one section of the punch with an explosive force that may cause extreme distortion or even tearing of the part. Tallow or beeswax is employed for lubricating the punch.

Standard inclinable or straight-sided punch presses can be used for cold impact extruding operations. For parts having a compressive area *A* up to 1/2 square inch, a press capacity of 25 tons should be provided; for parts up to 1 square inch, 60 tons; for parts up to 2 square inches, 100 tons; for parts up to 2 1/2 square inches, 200 tons; for parts up to 3 square inches, 450 tons; for parts up to 5 square inches, 800 tons.

For operations where presses of the required

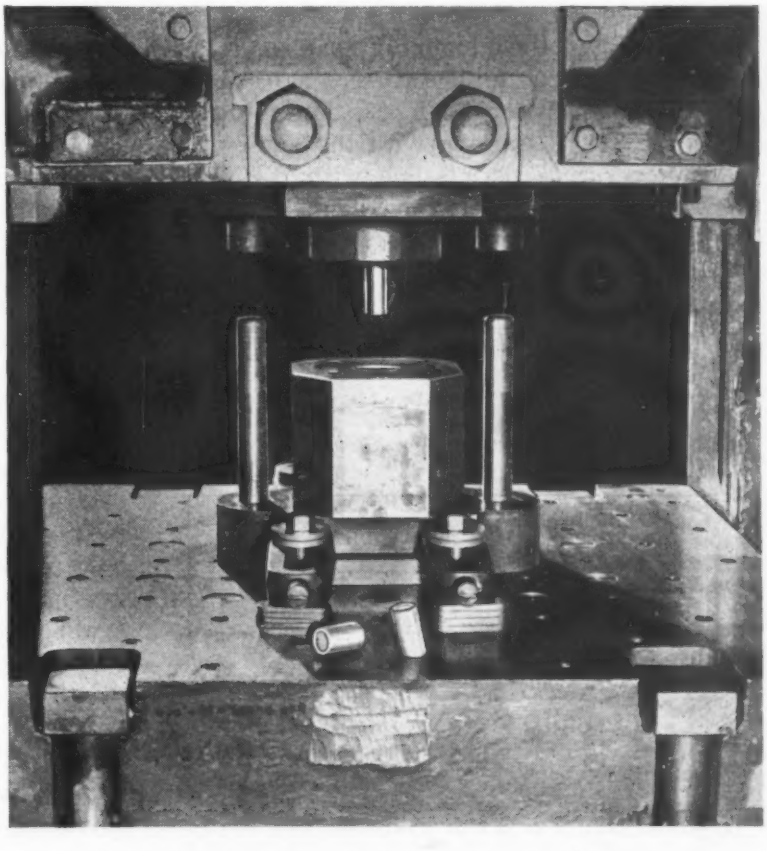


Fig. 9. Another Extrusion Die of the Regular Type which Produces Small Cylindrical Parts with a Recessed Bottom that is Located at a Considerable Angle with Respect to the Cylindrical Wall

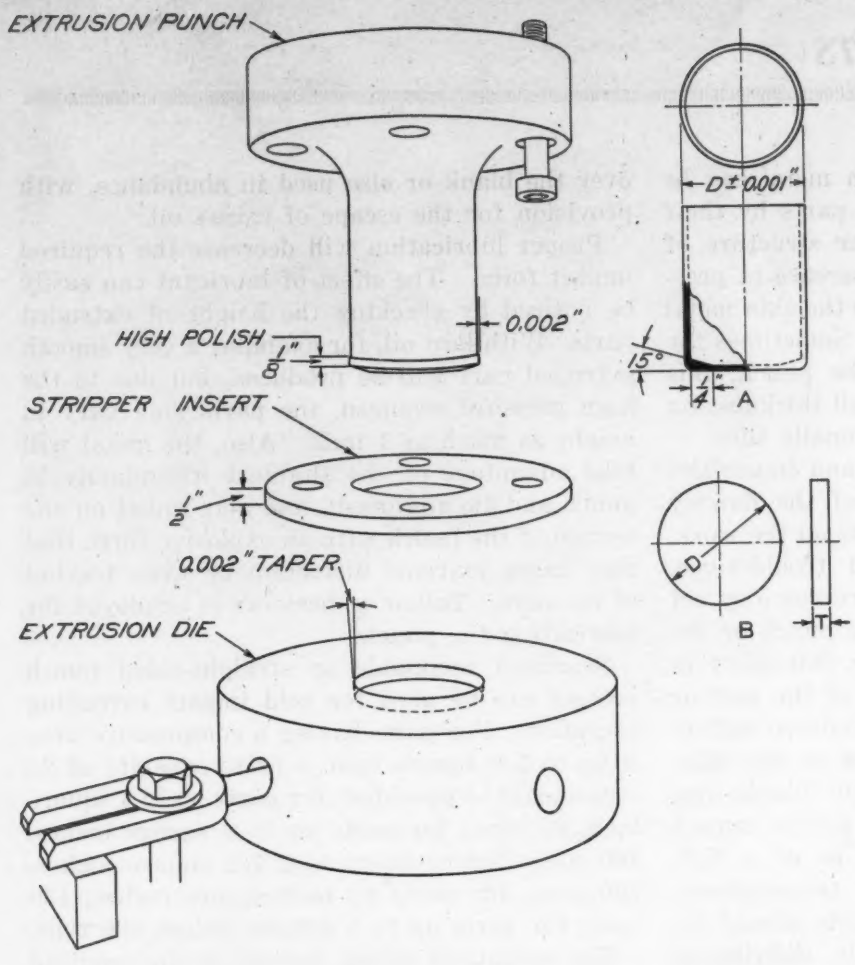
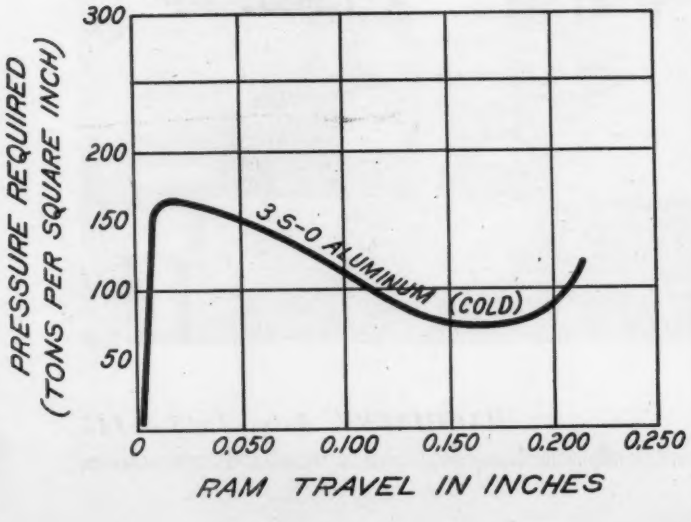


Fig. 10. (Left) Simple Impact Extrusion Die of the Regular Type which was Designed for Producing a Cylindrical Cup of the Shape Indicated at A from Slug Shown at B

Fig. 11. (Below) Diagram which Indicates the Tons per Square Inch Exerted at Various Points during the Travel of the Press Ram in an Operation on 3S-O Aluminum Alloy

capacity are not available, a smaller press can be employed if the aluminum blanks are preheated to from 200 to 600 degrees F. The most desirable temperature can be determined by experimentation, starting with the highest possible temperature permissible with the particular aluminum alloy being extruded. Too much heat will affect the quality of the part. Temperatures should be maintained within plus or minus 5 degrees to insure uniform parts and to protect the tools and press.



Punches and dies should be made from a good grade of steel. Douglas engineers have adopted high-chromium high-carbon steel for this purpose. Dies are customarily hardened to between 55 and 57 on the Rockwell C scale, and punches to between 58 and 60.

No matter how good the condition of the press on which an extruding operation is being performed, the sudden impacts made by the punch will necessitate adjustments of the ram from time to time. Therefore, the bottom and wall thicknesses of the work-pieces should be checked periodically, preferably by means of gages equipped with dial indicators.

The pressure exerted on the blank or slug in cold impact extrusion is not consistent. It appears to be of maximum force at the starting point when normal conditions prevail, then gradually tapers off to the minimum force, and again increases toward the end of the stroke, at which time the pressure may even exceed the starting force if the bottom of the part is very thin. Fig. 11, a chart which is based on knowledge obtained from experiments, gives a graphic illustration of the pressure fluctuation while extruding a cup 2 inches in diameter with a

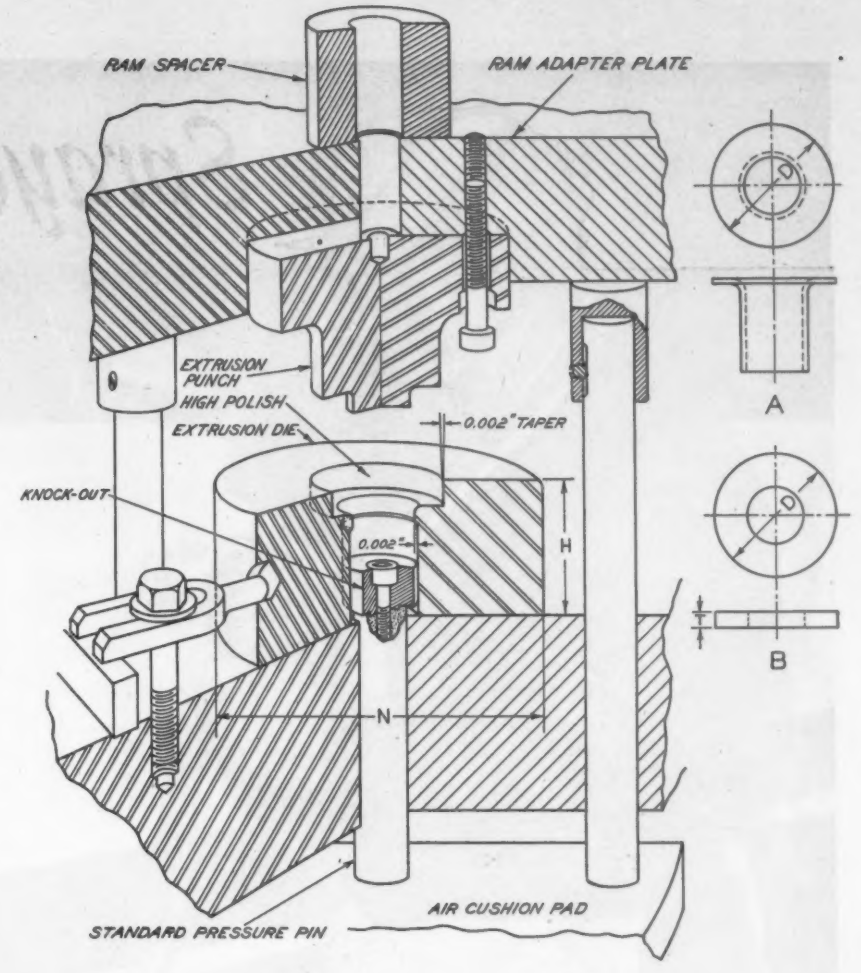


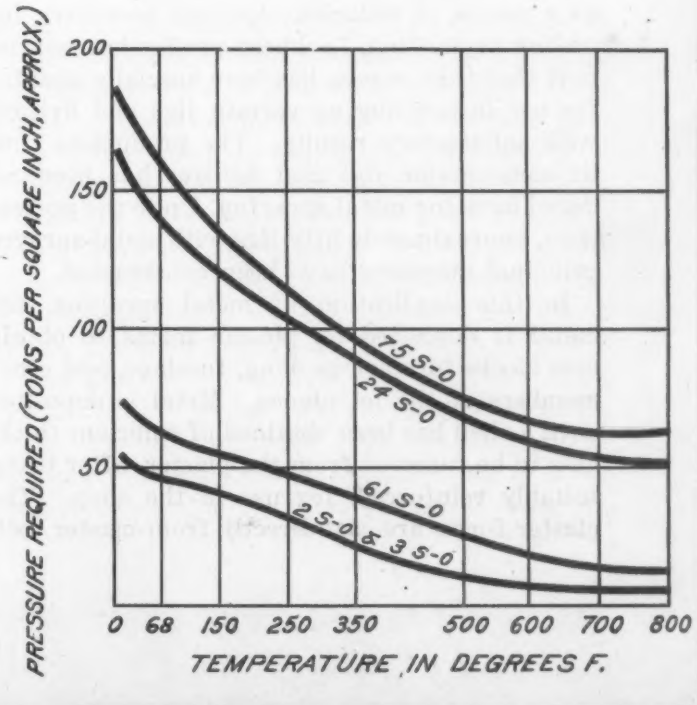
Fig. 12. (Right) Diagrammatic Illustration of a Hooker Process Die Designed for Extruding the Flanged Tubular Piece at A from a Disk-like Slug having a Central Hole

Fig. 13. (Below) Diagram that Shows how the Heating of Blanks to Various Temperatures prior to Extrusion Reduces Required Pressure for Impact Extrusion Operations

wall and bottom thickness of 1/32 inch from a slug of 3S-O aluminum alloy, 1/4 inch thick.

Estimates of pressure requirements should be multiplied by the safety factor of 2 before selecting the pressure to be used and determining upon the die cavity cross-sectional dimensions and the area of the punch bottom. The appreciable effect that preheating the slugs or blanks has on the required pressure will be apparent from the chart Fig. 13, which shows the pressure required in tons per square inch for various types of aluminum alloy at preheated temperatures ranging from 0 to 800 degrees F. This chart was derived from observation during the actual production of extruded parts, and is based on a unit slug area of 1 square inch and a slug 1/4 inch thick.

The length of the surface on the end of a punch which actually controls the inside diameter of the extruded part has an important influence on the flow of the metal in extrusion operations. In order to limit the friction provided by the surface, which is typical on all impact dies, the surface should be made only about 1/8 inch long, as seen at the lower end of the punch in Fig. 10, and then a relief of approximately 0.002 inch should be provided in back of this extruding surface, which is highly polished. Sometimes this aperture controlling surface is made wider than 1/8 inch in order to increase the friction and better control the metal flow in the extrusion of parts that are unsymmetrical in cross-section.



Sprayed-Metal

AS part of its intensive development program for the manufacture of the sensational jet-propelled P-80 Shooting Star, Lockheed Aircraft Corporation has had to use short-cuts in manufacturing. The construction of major jigs and fixtures was called for on a particularly tight schedule.

Metallizing, or metal spraying, was considered as a means of reducing the time necessary for tooling production. Lockheed production men report that this process has been specially adapted for use in building up certain jigs and fixtures with satisfactory results. The production time on some major jigs and fixtures has been reduced by using metal spraying. Up to the present time, approximately fifty jigs with metal-sprayed principal members have been constructed.

In this application of metal spraying, the metal is deposited on plaster forms to obtain nest blocks for various wing, fuselage, and other members of the jet planes. Metal is deposited until a shell has been obtained of sufficient thickness to be removed from the plaster, after being suitably reinforced, for use in the shop. The plaster forms are cast directly from master tooling models. This practice insures that the nest blocks will be accurate as to dimensions and contour with reference to the parts they support during drilling and assembling operations, and guarantees completely interchangeable aircraft parts and sub-assemblies.

The exact duplication of contours on the surfaces of wing, fuselage, and other airplane parts is an absolute requirement, in addition to the interchangeability of holes and other details. The only way to insure exact duplication of contours is to make physical reproductions from the master tooling models or mock-ups. Thus, master tooling models are used to establish contours, trim lines, hole and part locations, and various loft reference points, lines, and planes on such tools as gages; checking fixtures; bluing blocks; forming dies; stretch, router, shaper, and form blocks; jigs; fixtures; and patterns.

The problem confronting the tool planner, designer, and maker is the transfer of the lofted contours and hole patterns from the master tooling model to the various major assembly tools, so as to establish positive coordination between parts and sub-assemblies fabricated with the

Jig Members Speed up Jet Plane Production

The Lockheed Aircraft Corporation Applies Metal Spraying to Save Time in Constructing Nest Blocks for Major Jigs and Fixtures

By CHARLES O. HERB

aid of these tools. Metal spraying is a speedy means of accurately transferring loft data from the master tooling models to the tools or jigs.

Master tooling models are made by Lockheed from wood, plaster, or plastics. Frequently they contain metal bushing inserts to which tooling pins can be attached for locating bushings in plaster forms cast from the master tooling model.

Two of the metal-sprayed nest blocks are seen in Fig. 1 mounted on picture-frame jigs. These nest blocks are for a door panel on the leading edge of jet-plane wings. Drill cages which also conform to the shape of the work are seen suspended above the nest blocks. After the door panels have been loaded on the nest blocks, the drill cages are lowered into place, properly located, and clamped.

The first step in making the metal-sprayed nest blocks is to cast a reverse plaster impression directly on the reference faces of the master tooling model. This plaster reverse is split lengthwise in order to obtain two halves that can be readily removed later from the metal-sprayed nest block. To prevent distortion of the plaster reverse halves, structural braces are mounted on the rear side of each half. Sisal is wrapped around various parts of the structure to bind it to the plaster forms, and the sisal is soaked with plaster. Fig. 3 shows two halves of one of these plaster reverses mounted on their structural frames. The two halves are coordinated with each other by means of locating devices attached to the reinforcing structures.

At the time of pouring the plaster on the master tooling model, tooling pins are inserted in the bushings of the model and other bushings are fitted over these pins to be embodied in the plaster. These bushings establish the hole pattern of the model on the plaster impressions.

The next step in the process is to coat the mold surface of the plaster impressions with a mixture of kerosene and styrene. This coating will prevent the metal from actually adhering to the plaster impressions when it is sprayed on. Fig. 2 shows a plaster form coated with the mixture.

The two halves of a plaster mold are then assembled by means of the locating devices, ready for the metal-spraying operation. The heading illustration shows metal being sprayed on a one-piece plaster form of such a construc-

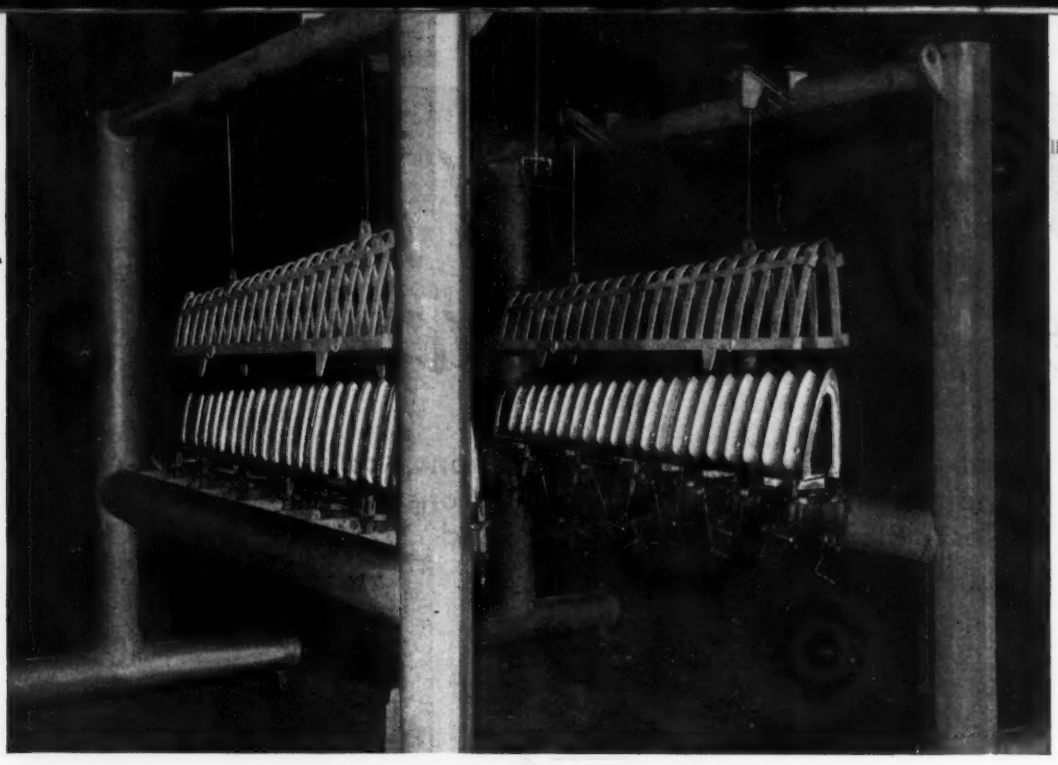
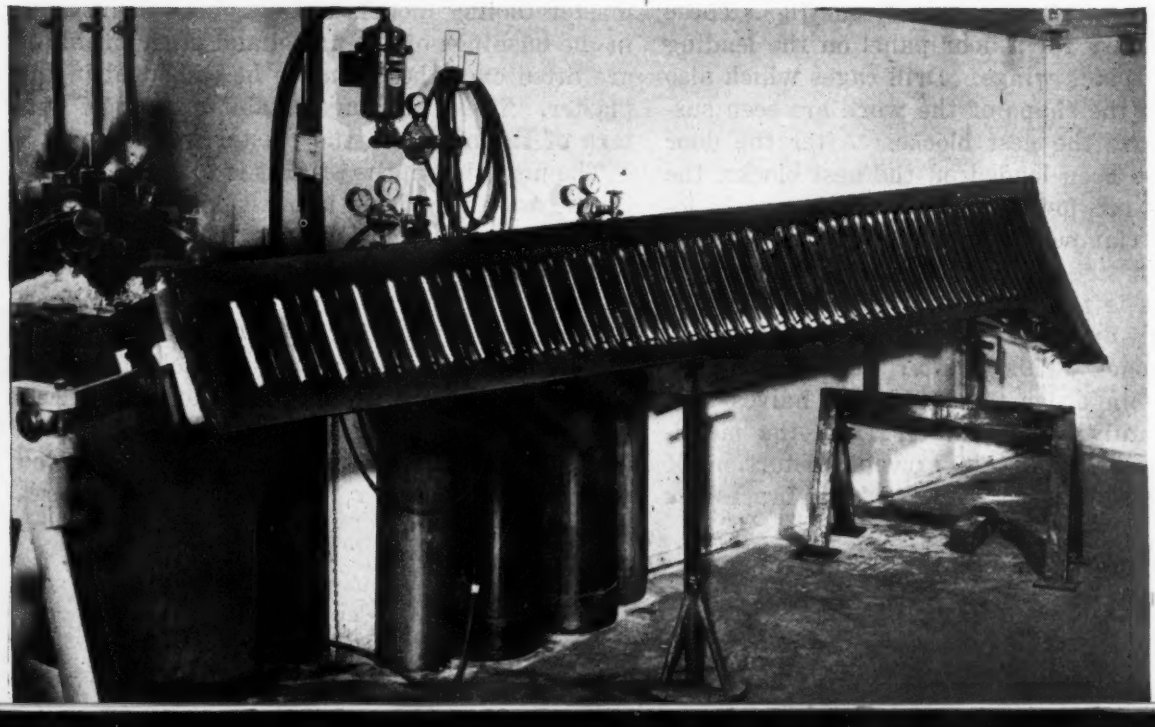


Fig. 1. Two Typical Nest Blocks for Airplane Wing Leading Edges Constructed of Shells Built up by Metal Spraying and Reinforced on the Inside with a Steel Structure

tion that two halves were not required, while Fig. 4 shows the full length of the same plaster impression after a light coat of metal has been sprayed on. Metal to a thickness of at least 1/8 inch is sprayed on the plaster forms in the preliminary step. Ordinarily, the metal is pure zinc, and is fed through a Metco No. 3 gun in wire form in the conventional manner. Sometimes, a zinc aluminum alloy wire is used right from the beginning of the operation.

In using zinc wire, a pressure of 12 pounds per square inch is applied on the acetylene line and a pressure of 14 pounds per square inch on the oxygen line. In using aluminum, bronze, or brass wire, a pressure of 14 pounds per square inch is used on the acetylene line and a pressure of 16 pounds per square inch on the oxygen line. An air pressure of approximately 70 pounds per square inch, provided by a small turbine, is directed on the wire where it is fed into the gas

Fig. 2. Plaster Form or Mold for Work-supporting Member of a Wing Inner-skin Trimming Machine after It has been Coated to Prevent the Sprayed Molten Metal from Combining with the Plaster



flame. This blows the molten metal off the end of the continuously melting wire and on the work being coated.

The end of the wire is never held closer than about 2 1/2 inches from the work, so that the metal is actually atomized in a molten condition as it leaves the wire. When the metal hits the plaster form, or the previously laid metal, it is no longer in a molten condition, but in the form of small putty-like balls of metal, which adhere to the previously laid metal. The wire is fed to the gun by an air motor.

After zinc has been deposited to a thickness of approximately 1/8 inch all over the plaster form, a light coating of aluminum is sprayed on, and sometimes also a coating of bronze to increase the stiffness of the shell. With the Metco No. 3 gun, metal is sprayed at the rate of approximately 40 pounds of wire per hour. Bushings mounted on tooling pins that project from the bushings in the plaster form are embedded in the sprayed metal.

To reinforce this metal shell so that it will withstand severe usage along assembly lines, a structural steel frame is fitted into place while the shell is still within the plaster forms on the spraying fixture. A layer of metal is then sprayed on this structure to tie it to the built-up shell. Then expanded metal mesh is fitted into the structural steel frame, as shown in Fig. 5, and also fastened to the shell and the frame by spraying on more metal. Upon the completion of this step in the process, the inside of the metal shell appears as shown in Fig. 6.

When the expanded metal mesh has thus been fastened in place, the thickness of the shell is approximately 3/8 inch, although it may be as great as 3/4 inch at some critical point, and the entire framework is covered by at least 1/8 inch of metal. In Fig. 7, a built-up shell is seen from the open side, mounted on the trunnion fixture on which the metal spraying was done.

Steel plates 1/4 inch thick are now fitted into the long opening on the rear side of the shell to close this opening, and also into the ends, as seen in Fig. 8. These plates are added both for reinforcement and appearance. They may be provided with lightening holes, as in the example shown. All of these plates are finally sprayed with a light coat of zinc, so as to give the nest block a uniform finish all over.

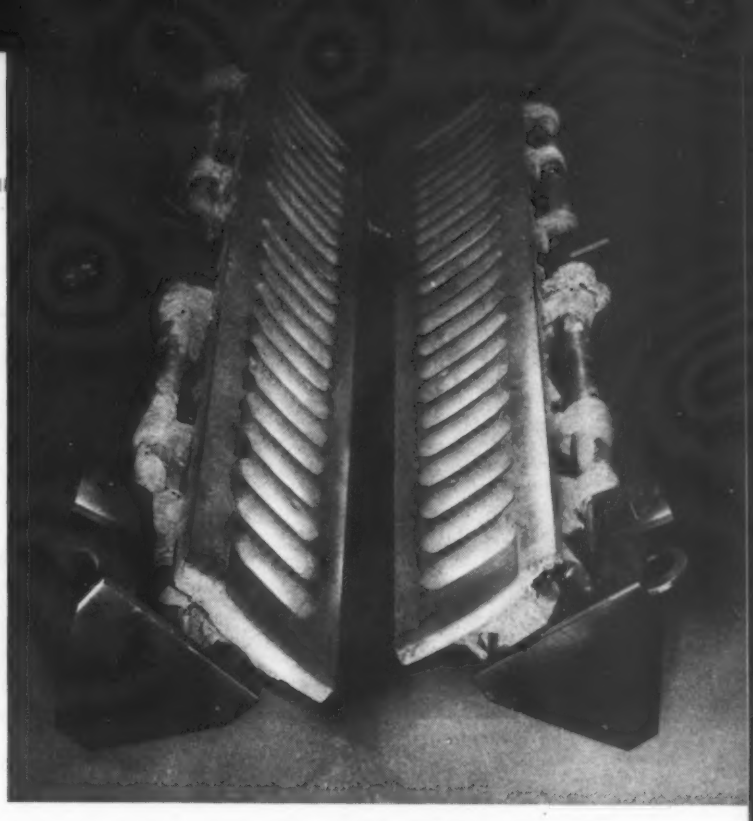


Fig. 3. Two Halves of a Plaster Form or Mold Taken from a Master Tooling Model, on which Metal will be Sprayed for the Development of a Shell that will Provide the Work-supporting Surfaces of a Nest Block

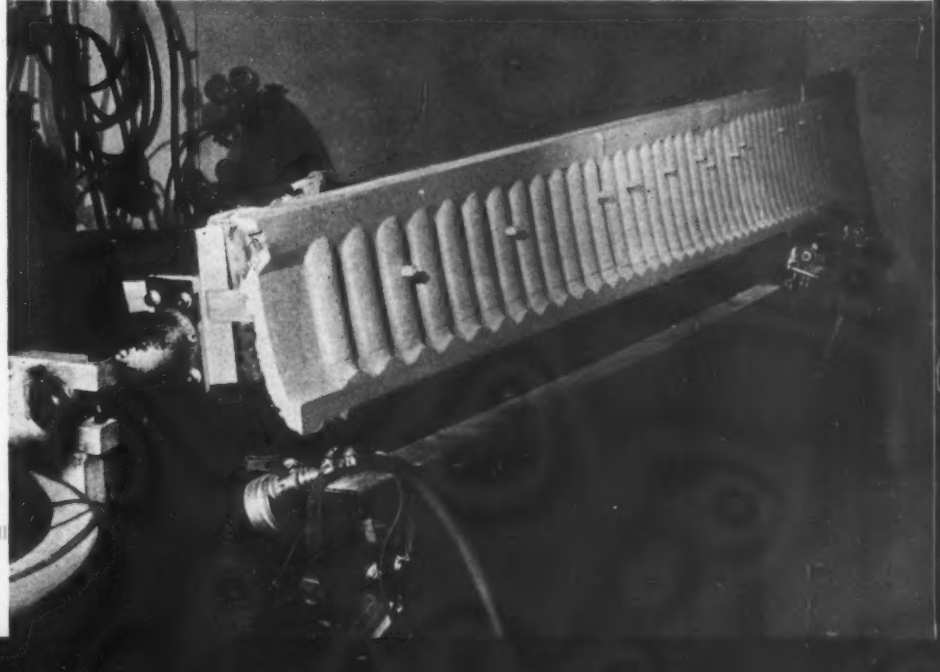


Fig. 4. Another View of the Plaster Form in Fig. 2 after a Light Coating of Pure Zinc has been Sprayed on It; Spraying is Performed Progressively, up and down, and End for End

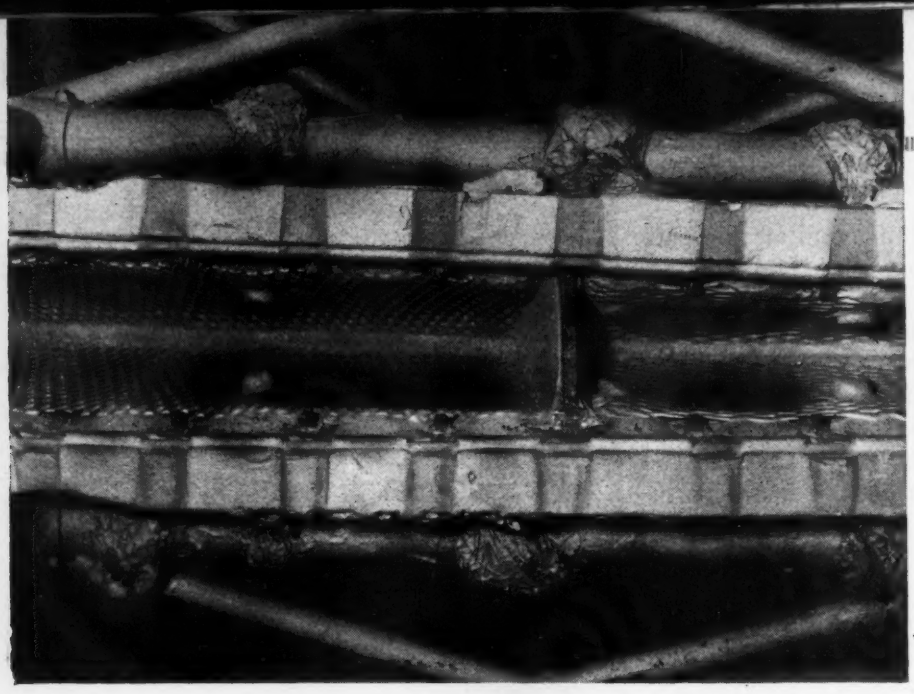


Fig. 5. The Inside of the Sprayed-metal Shell is Reinforced with a Steel Structure and Expanded Metal Mesh. Zinc is Sprayed on the Reinforcing Members to Fasten Them to the Shell

Except for removing the sprayed-metal shell from the plaster mold, the nest block is now completed, and ready for installation on a tubular jig frame, as seen in Fig. 9. This particular nest block is for a leading-edge inner skin. The recesses, or corrugations, are required for the "hot wing" construction. Skeleton drill jigs or hold-down frames, built up by welding to designs such as seen in Fig. 1, will be provided to suit the contour of the nest block. Steel bars 1/4 or 3/8 inch thick by 3/4 to 1 1/4 inches wide are generally used in making these drill jigs. They are provided with means of accurately locating them on the nest block, and are furnished with suitable drill bushings.

Although this article has stressed the application of the metal-spraying process to the building up of jig nest blocks, similar metal forms or shells have been produced by the same method for other applications. There are, for example, several trimming machines on which wing skins are held on metal-sprayed forms while the edges of the skins are machined to close dimensions by means of small saws. In fact, the plaster forms seen in the heading illustration and in Figs. 2 and 4 were used for the metal spraying of work-holding members for such machines.

Standard support bases are usually made from Masonite or steel plates, with the contour formed to templets, or from a plastic material or wood laminated to a solid block. The sprayed metal compares favorably in strength with any other material, except steel or reinforced Masonite.

This development has been of importance to Lockheed Aircraft Corporation, and considerable time and money have been spent on improvement of the metallizing process and its application to aircraft tooling. All proprietary rights to Lockheed improvements are reserved by the company.

Fig. 6. The Appearance of the Inside of a Sprayed-metal Shell with Expanded Metal Mesh in Place, the Shell Still being Contained within the Plaster Impressions of the Master Tooling Model

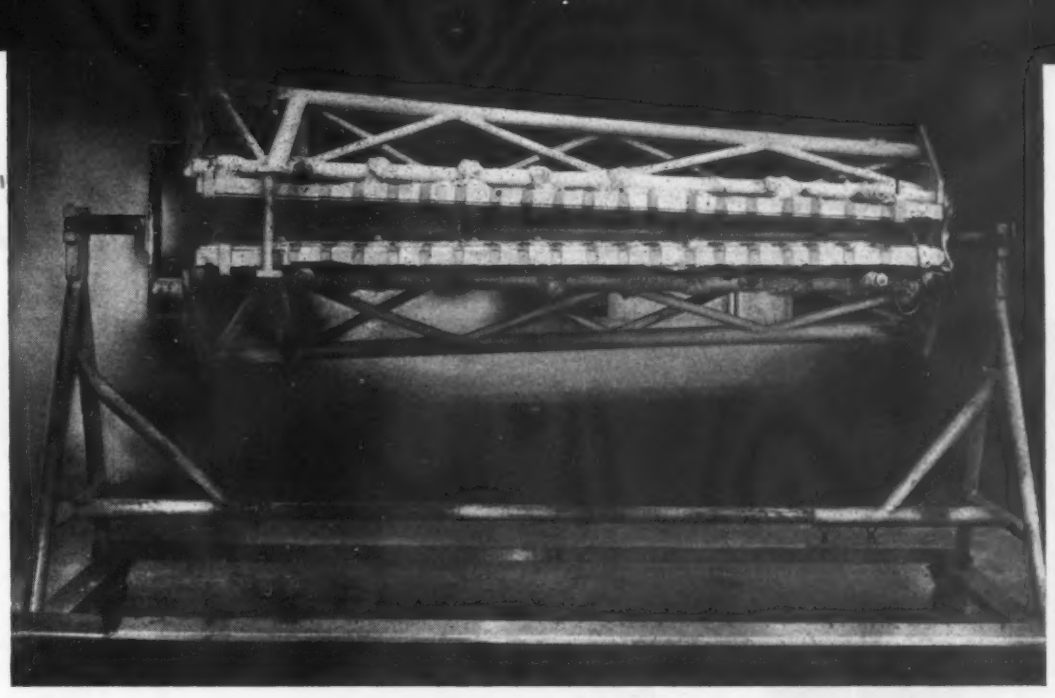


Fig. 7. (Above) General View of a Sprayed-metal Nest Block Taken from the Rear Side while It is Still Mounted on a Trunnion Fixture Such as Used in the Metal-spraying Operation

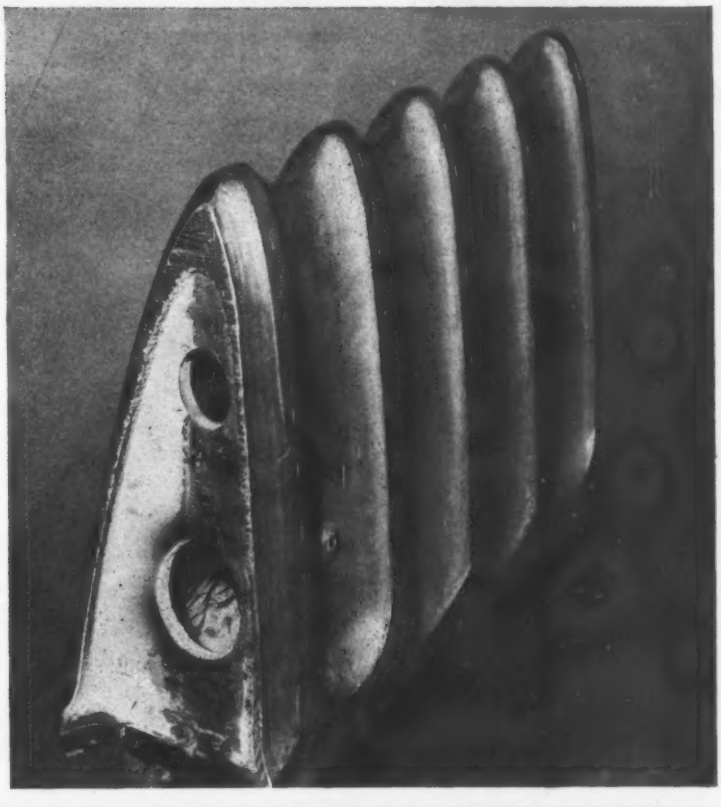
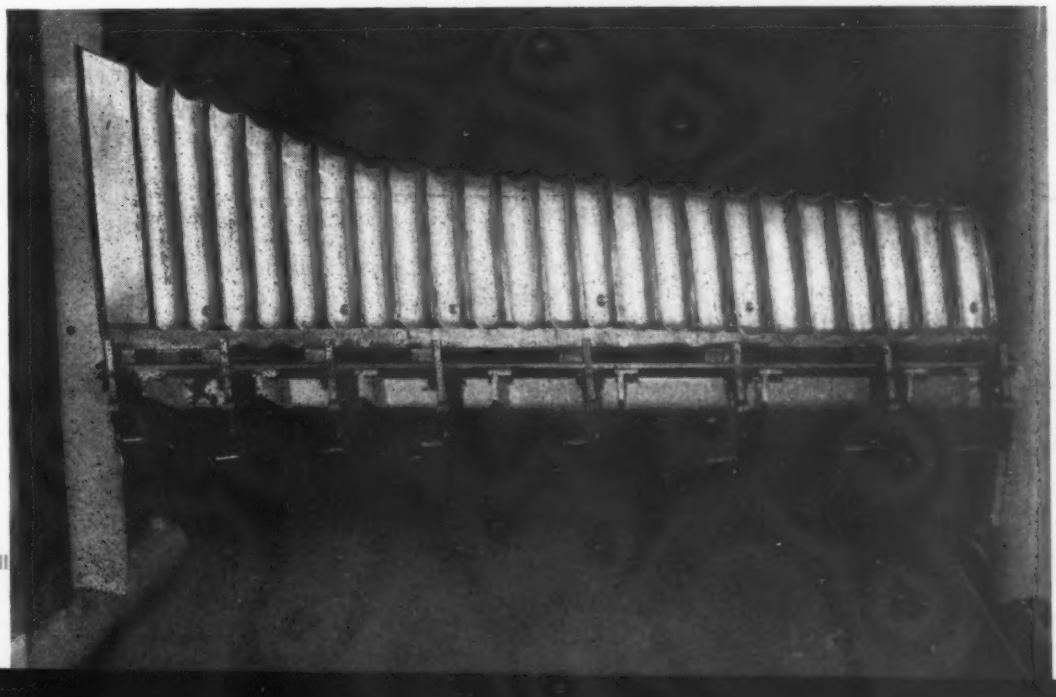


Fig. 8. (Right) View of a Comparatively Small Sprayed-metal Nest Block Showing the Steel Plate that has been Fastened in One End, also by Metal Spraying, for Reinforcing Purposes

Fig. 9. (Below) Installing a Metal-sprayed Nest Block on a Jig of Tubular Construction, Ready for Service along a Jet-plane Assembly Line; a Skeleton Drill Cage will also be Provided



Heat-Treating and

A Rivet Handling System that Insures Efficient Use of Heat-Treated Rivets and Reclamation of All Types from Floor Sweepings

By HARRY F. VOLLMER
Vice-President of Manufacturing
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Baltimore, Md.

Refrigerating Aluminum-Alloy Rivets for Martin Planes

RIVETS individually are infinitesimal compared with a completed airplane, but collectively the rivets required in building a single plane represent one of the most important items in its construction. For example, each one of the twenty huge Mars flying ships now under construction at the plant of the Glenn L. Martin Co. will require over 3,000,000 aluminum-alloy rivets for the fabrication of the hull, wings, and other plane members—60,000,000 rivets for these flying ships alone. The Martin Mariners, which have been produced in large numbers, necessitate 566,000 rivets per plane.

With such great quantities of rivets required in aircraft manufacture, it is essential to establish a control system that will guarantee the utmost efficiency in the heat-treatment of aluminum-alloy rivets, in maintaining the rivets in the unaged condition until they are delivered to the riveters, and in the salvage of unused rivets. With the current shortage of rivets due to the man-power situation in rivet manufacturing mills, adequate rivet control is especially imperative at this time. The Glenn L. Martin Co. believes that it has established what is probably one of the most efficient rivet-handling systems of any aircraft plant.

The principal feature of this system is the department set up for the heat-treatment of aluminum-alloy rivets and the storage of all 24ST rivets under refrigeration until supplied to the riveters throughout the plant. A general view of the electric heat-treating furnaces with water quench tanks and alcohol drying tanks in this department is presented in the heading illustration. To the left of this equipment, but not visible in the illustration, is a battery of National cold-heading machines which produce some of the rivets used in this and other Martin plants and by sub-contractors who fabricate parts for Martin planes. A large proportion of the rivets are purchased directly from mills. Also at the left of the department, and not seen in the photograph, are several of the refrigerating units employed for rivet storage.

Fig. 1. The Basket Used in Heating the Aluminum-alloy Rivets is Constructed with Ten Tubes of Stainless-steel Wire Mesh, which Permits Ten Different Sizes of Rivets to be Handled Simultaneously

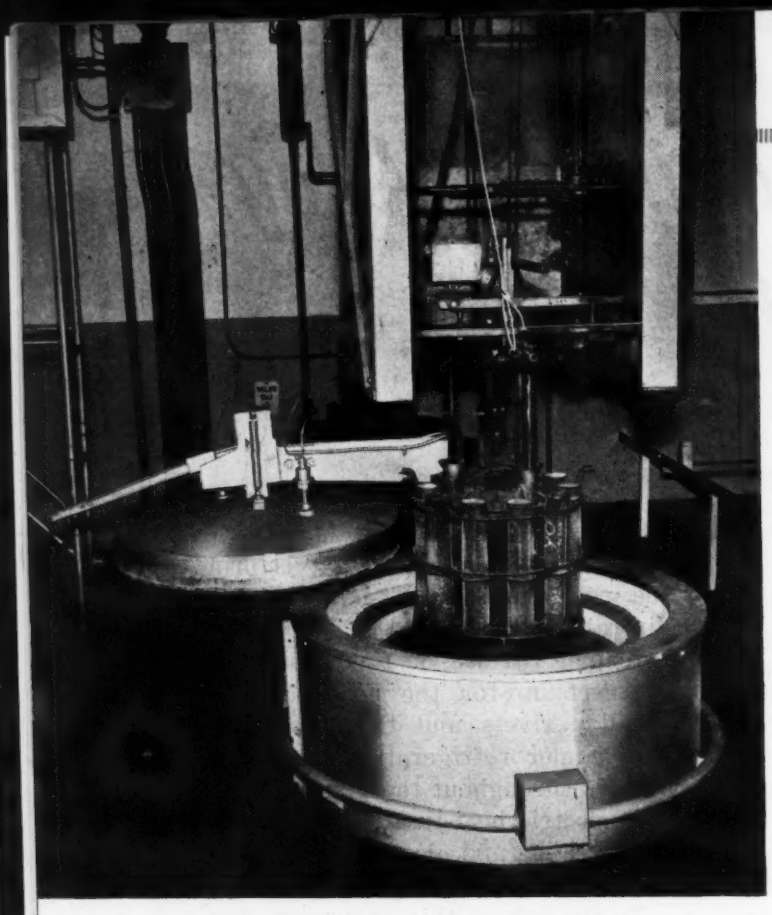
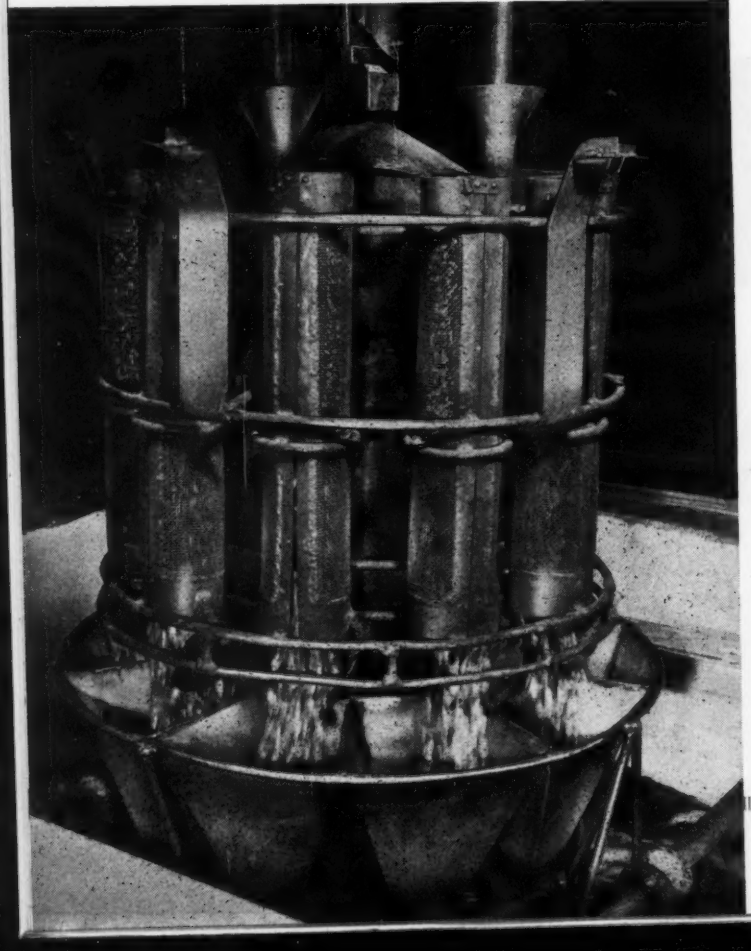


Fig. 2. Lowering a Basket of Aluminum-alloy Rivets into One of the Electric Furnaces where It will be Held for 1 1/4 Hours

Fig. 3. Dumping the Heated Aluminum-alloy Rivets into a Water Quench within Fifteen Seconds after Their Removal from the Electric Furnace Shown in Fig. 2



Rivets from 1/16 to 1/4 inch in diameter and from 3/16 to 1 inch in length are produced on the heading machines of this heat-treating department, particularly all types of special rivets that are not readily available from outside sources. The output of A17S rivets produced by the heading machines is sent through the heat-treating process, run through a drying unit, and then sent to a room where they are held under lock and key.

Test samples of all rivets are sent from this room to the metallurgical laboratory for a rigid investigation of the physical properties of each batch. Those that meet requirements as to the physical properties are next delivered in sealed bags to the quality control division, which sends them to the anodizing department. After the performance of the anodizing operation, the rivets are checked by both company and Government inspectors and returned, again in sealed bags, to the heat-treating department, where they are stored until required at assembly jigs.

The storage of these rivets in a locked room and their transfer from department to department in sealed bags is stringently observed, in order to prevent the possibility of any unprocessed rivets from reaching the riveters.

Five hundred and ninety-six different sizes of rivets are handled by the heat-treating department. As a matter of interest it may be pointed out that the smallest size of rivet handled averages 991 to the pound, and the largest size 75 to the pound. The efficiency of this heat-treating department is such that two girls perform all heat-treating operations.

The first step in the heat-treating process is to load the rivets from bin stocks into a basket of the type seen in Fig. 1. This basket is constructed with ten wire-mesh tubes into which the rivets are poured. It is the practice to load rivets of different sizes into different tubes, so that ten sizes can be run through the operation at one time. The heat-treating basket is made with a hollow cylindrical member in the center which is covered with a domelike sheet of metal, so as to confine the circulation of heated air in the furnaces to the vicinity of the rivet-loaded wire-mesh tubes.

In the very center of the basket and at its top is seen a lift-block of unusual shape, which is engaged by jaws on a hoist for lifting the basket and transferring it through several steps of the

heat-treating process. There are also three funnel-like tubes spaced around the basket inside of the rivet holding tubes, which are engaged by three rods whenever the lift-block is gripped by the hoist jaws. With this arrangement, the basket is prevented from swiveling as it is being handled by the hoist.

The lift-block is attached to the upper end of a rod which extends downward to the bottom of the basket, where it is connected by a linkage system to hinged trap doors, which ordinarily close the bottom end of the rivet holding tubes. After the rivets have been heated and the basket is transferred to a water quench tank, all these trap doors are automatically opened to permit the rivets to fall from the basket into the quench. The heat-treating baskets are constructed completely of stainless steel to withstand the severe service imposed on them. About 50 pounds of rivets are customarily loaded in one of these heat-treating baskets at a time.

The hoist that serves the heat-treating furnaces and quench tanks runs on a track extending the full length of the department. Suspended from the hoist is a cage which guards against attendants being injured from contact with hot baskets of rivets. Operation of the hoist is controlled from a switchboard, seen at the left in the heading illustration. The movements of the hoist from furnace to water quench tank and to the alcohol bath can be automatically or manually controlled. This is also true of the hoist operation in any location.

The jaws of the hoist unit which grip the lift-block on the heat-treating baskets are automatically opened as the hoist lowers the jaws over the tapered top edge of the lift-block. The jaws then snap shut under spring pressure against the thinner portion of the lift-block that is directly below the tapered head. After a basket has been lowered into a furnace, the jaws are opened manually through a lever to release the basket from the hoist unit. The basket gripping and lifting mechanism of the hoist operates up and down within the hoist cage on rollers that run on the inside legs of the two front angle supports of the cage.

In Fig. 2, the hoist is shown lowering a basket of rivets into one of the three Homo electric furnaces in the department. These furnaces are operated at a temperature of between 920 and 930 degrees F. The basket of rivets is held in

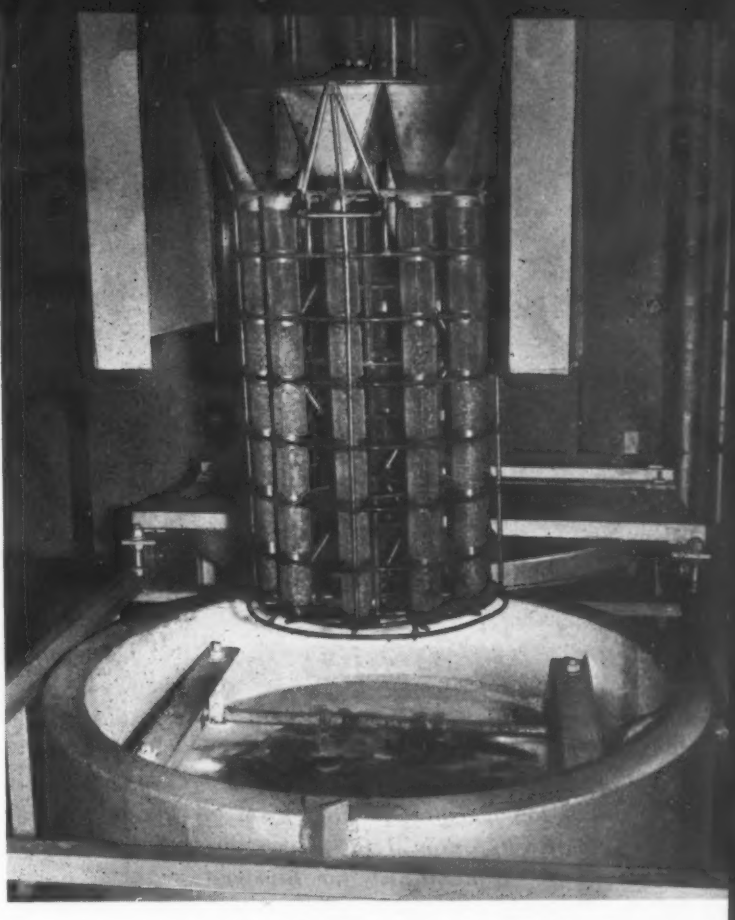


Fig. 4. Withdrawing a Batch of Rivets from the Water Quench. Illustration Shows Clearly Construction of Quenching Baskets

Fig. 5. Withdrawing a Basket of Heat-treated Rivets from an Alcohol Bath which Helps to Dry the Rivets and Prevents Them from Freezing together in the Refrigerators

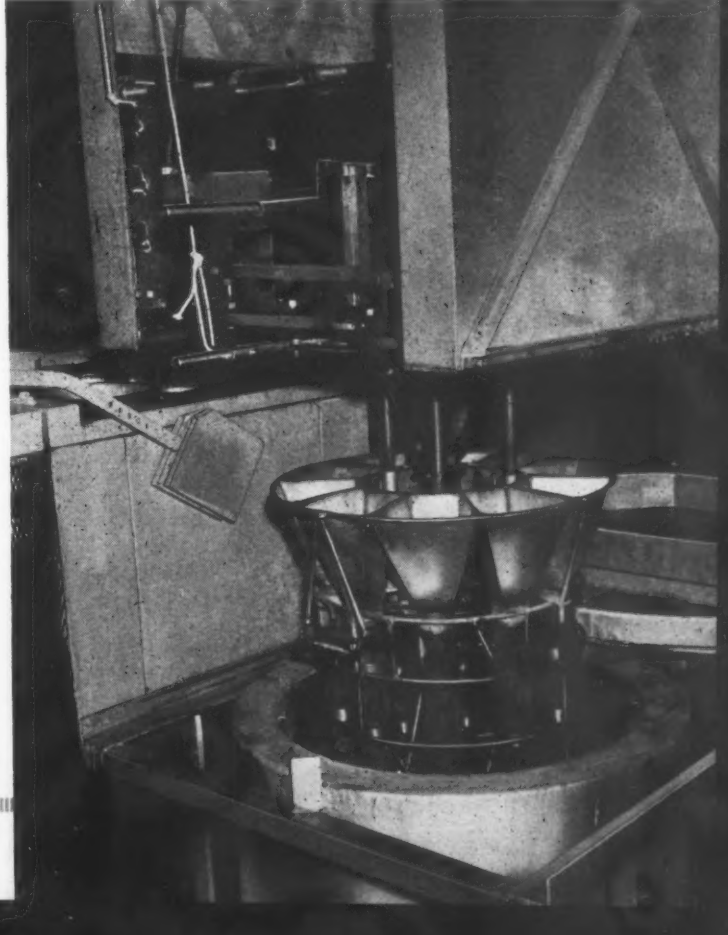


Fig. 6. Ten-compartment Indexing Table in a Refrigerated Cabinet Used for Loading Rivets into Metal Tubes of a Convenient Size for Riveters

Fig. 7. Loading Heat-treated Rivets into Tubes in which They are Stored in the Refrigerators and Finally Supplied to the Riveting Jigs

the furnace for one hour and fifteen minutes, during which period heated air is well circulated through the rivets by means of a blower arrangement.

At the end of the heating period, the basket of rivets is withdrawn from the furnace by the hoist and quickly transferred to a water quench tank at one side of the furnace. This tank has been previously supplied with an empty ten-compartment basket, the upper end of which can be seen in Fig. 3. The hot rivets are immediately dumped into this basket, as shown in the illustration, by opening the trap doors at the bottom of the wire-mesh tubes on the heat-treating basket. The rivets fall into the somewhat longer wire-mesh tubes of the quench basket. The interval of time between the opening of the heat-treating furnace and the delivery of rivets into the water quench is held to not over fifteen seconds.

A refrigerating system maintains the temperature of the water in the two quench tanks of the department at between 38 and 40 degrees F. The water is constantly circulated at a pressure that is sufficient to keep the water agitated. The rivets remain in the water quench until they have attained the temperature of the quench. The covers of the quench tanks are mounted on ball-bearing casters, which run on angle-iron tracks at the side of each tank, as seen in Fig. 4, so as to facilitate opening and closing the tanks. The complete construction of the quench baskets is also shown in this illustration. The baskets are about 4 1/2 feet in height, the water quench tanks being approximately 5 feet in depth and 5 feet in diameter.

After the rivets have been in the water quench the required length of time, they are immediately transferred to a tank of denatured alcohol, which is seen in Fig. 5. This tank is made slightly smaller in diameter than the water tanks, so as to reduce the amount of alcohol required at one time. The alcohol bath is maintained at a temperature of zero degrees F. through refrigerating coils installed around the inside of the tank.

This alcohol dip helps to dry the rivets and provides them with a light coating that prevents them from freezing together when they are later stored in the refrigerator units in which they must remain until delivered to the riveters. Without this coating, the rivets would freeze

together into large clumps and could be separated only with difficulty.

From the alcohol bath, 24ST rivets are transferred to the refrigerated loading box or cabinet seen in the left background of Fig. 5. The top of the loading box, with the cover open, appears as shown in Fig. 6. There is a cylindrical indexing table with ten compartments to correspond with the number of tubes on the quench baskets, so that the quenched rivets can be dumped into the loading box and be kept separated according to size, as they were in the heat-treating and quenching baskets.

As soon as the complete contents of a quench basket have been dumped into the tube loading cabinet, the lid is closed and the cabinet is pushed on tracks across the department to a position beside several Kold-Hold refrigerators, such as seen in the left background of Fig. 7. The rivets in the loading cabinet are then discharged into metal tubes 2 inches in diameter by 6 inches in length as they slide from one of the compartments of the indexing table, which is lined up with the tube that leads to the discharge chute seen at the bottom of the cabinet. When all of the contents of one container compartment have been loaded into tubes, the container is indexed to bring another compartment into line with the unloading tube. In this manner, the rivets are still kept separated according to size.

The loaded tubes are immediately transferred to the refrigerator cabinets, as indicated in Fig. 8. Each of these cabinets has a capacity for holding 300 tubes of rivets at a time. These refrigerator units are maintained at a temperature of 32 degrees below zero, and hold 24ST rivets soft enough for driving for a long period.

Other cabinets, which are refrigerated by dry ice and mounted on trucks, are used for delivering the tubes of rivets to the riveting jigs throughout the plant as they are required. Because stringent regulations have been set up limiting to twenty minutes the length of time that these rivets can be out of refrigeration until they must be driven, the practice is to take as small a quantity of rivets from the cabinets at one time as will meet actual demands. The importance of observing this rule is constantly stressed. All 24ST rivets that have been in room atmosphere for this limited period without being used are set aside to be heat-treated over again. The heat-treating operation can, of

Fig. 8. View of One of the Refrigerators of the Heat-treating Department in which the Tubes of Rivets are Stored until Shipped into the Plant

Fig. 9. Magnetic Separator which Sorts Steel and Aluminum-alloy Parts from Floor Sweepings for Salvaging Operations that Save Thousands of Dollars

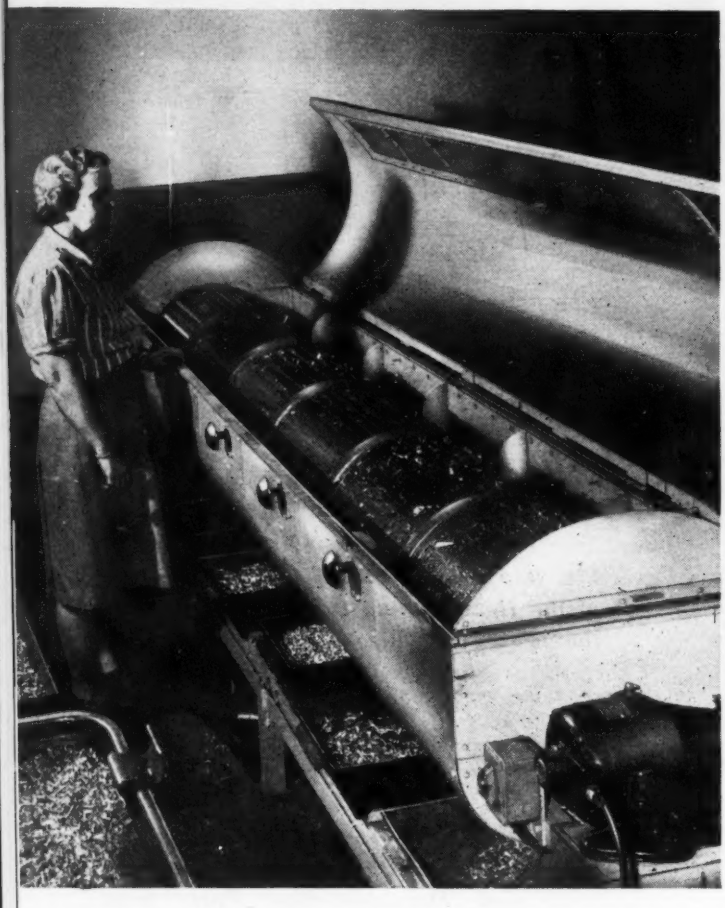


Fig. 10. Rotary Type of Machine which Sorts Rivets According to Diameter, the Rivets Falling through Slots in the Long Cage

Fig. 11. Special Machine Devised for Sorting the Rivets According to Length after They have been Sorted According to Head Type

course, be performed any number of times on the same rivets.

Rivets of the 24ST type, heat-treated in the department by the procedure here outlined, but which are to be shipped to sub-contractors or other Martin plants, are packed in dry ice for the shipment, so that they can be driven upon arrival at their destination or as required. Type A 17 S-T rivets are packed in cellophane bags after they have been heat-treated, quenched, and dried. Rivets of this type remain soft enough indefinitely for driving.

Thousands of dollars worth of rivets have been reclaimed from floor sweepings through the efforts of the sanitation and conservation departments. The rivet reclamation from this source alone amounted to 140,000 pounds in one year. In addition, tons of bolts, nuts, ball bearings, and various other small parts are salvaged annually from the sweepings.

The first step in rivet reclamation is to run the floor sweepings through a rotary type of machine which sifts the dust and dirt from the metal parts. The conglomerate collection of metal parts remaining is then shoveled into the hopper of a magnetic separator, such as shown in Fig. 9. This machine is equipped with a rotary magnetized drum, about 12 inches in diameter by 24 inches in length.

The magnetized drum revolves in a clockwise direction, as viewed from the left-hand side of the machine. All aluminum-alloy parts delivered to this drum slide off and fall into the bin at the back of the machine. Steel parts, however, are held to the drum by magnetic attraction until they come into contact with a thick rubber wiper in the front of the machine base which causes the steel pieces to fall into a receptacle within the machine.

All aluminum pieces coming from this mag-

netic separator are delivered to machines of the rotary type illustrated in Fig. 10. These machines are equipped with a rotary cage having hinged doors for loading the material to be salvaged and removing pieces that may be too large to pass through the narrow sorting slots of the cage. The latter is divided into six sections, each of which has slots progressively larger than those in the preceding section. The work-pieces move along the cage from right to left. As the cage revolves, the rivets fall through the slots, gaged by their head diameter, and drop into pans beneath the barrel.

From the rotary separator, the rivets are transferred to machines of the type illustrated in Fig. 12, which sort them according to the type of head—that is, flat or round. As the rivets pass from the hopper of this machine down a narrow slotted chute, they reach two blades that are set a predetermined height above the first chute to form a second chute. Flat-head rivets will pass under these blades and fall into a scoop at the base of the machine, which delivers the rivets through a tube to a receptacle beneath the table on which the machine is mounted. The round-head rivets are shunted into another receptacle.

From the head type separator, the rivets are passed to machines such as illustrated in Fig. 11, which sort the rivets according to length. The rivets slide down a narrow slot with the shank ends of the rivets downward and the heads toward the top, reaching a notched dial at the bottom of the slide.

When the rivets reach this dial, they are carried around the machine with the rivet heads resting on the top of the dial and the shanks hanging down through semicircular slots in the dial periphery. As the rivets move around the machine, the bottom ends of the rivets pass over the flat, hardened surfaces of ejectors attached to the stationary base on which the dial revolves. These ejectors are positioned at different heights. When the bottom end of a rivet comes in contact with one of these blocks, the head is raised from the dial and the rivet falls into a receptacle. There are sixteen of these receptacles placed around the machine, as shown, for sorting the rivets in length increments of 1/16 inch. Obviously, the longest rivets are sorted first and the shortest last.

All 24ST rivets are sent from this sorting department to the heat-treating department for reheating in order to obtain the required driving softness. They are then held under refrigeration until again sent into the plant. Other types of aluminum-alloy rivets that do not become too hard for use from exposure to room temperature are sent directly to stock-rooms from the sorting department.

Fig. 12. The Rivet-sorting Machine Used for Separating the Rivets According to the Type of Head, that is, by Flat or Round Heads

Silver-Brazing

Induction Heating, Gas Furnace, and Hot Dipping Methods are All Employed by a Concern that has Established a Reputation for High Quality Brazed Work

By RALPH H. RUUD, Assistant Factory Manager
North American Aviation, Inc.
Inglewood, Calif.

BRAZING has been widely adopted by North American Aviation, Inc., for the assembly of work-pieces that were formerly joined by oxy-acetylene welding. The principal advantage derived from the use of brazing is a much higher rate of production—a factor that has, of course, been of paramount importance during the war period. Another advantage is the neat appearance of brazed work after it has been cleaned of excess flux. Many parts that could be made in one piece only after the performance of a considerable number of machining operations can often be made up at an exceptionally low cost by brazing stampings and bar

Production Methods at North American

stock pieces together. Other parts that could not possibly be stamped in one piece from sheet metal can be produced in two or more pieces on punch presses and then joined by brazing into a one-piece part, also at minimum cost.

Both silver and copper brazing are extensively employed in North American plants, but this article will deal exclusively with silver brazing. Silver brazing is cheaper than copper brazing because less work is involved and because furnaces and other heating equipment need not be operated at nearly as high temperatures. Also, with silver brazing looser fits are possible between mating parts. Silver brazing, of course, cannot be used with work that must be later heat-treated, because high heat would melt the brazing metal. The strength of silver and copper brazed parts is comparable. Under shear tests, the strength of specimens has been at least 35,000 pounds per square inch.

Typical examples of silver brazed work are shown in Fig. 1. These parts are essentially metal stampings with small disks brazed to them to form bosses for bearings. In Fig. 2 are seen brackets made up from two blanked and pierced stampings and a shouldered bushing, which separates the two stampings the required amount. At the upper left, the three pieces that make up one of these brackets are seen assembled, with a ring of silver solder around one projecting end of the bushing, ready for the application of flux. A similar assembly is seen at the upper right with flux applied, ready for the brazing operation. The brazing material "Easy-Flo," which consists of 50 per cent silver and which is free floating at a temperature of 1175 degrees F., is used in all operations on steel parts, although at somewhat higher temperatures than that mentioned. "Fluxine" is used as the flux to prevent oxidation and to clean the surfaces to be joined, so that a solid homogeneous joint will be obtained.

At the top in Fig. 3 are shown three pieces that make up a shaft with a comparatively large diameter collar or flange. The shaft proper is first turned on a lathe to produce a shoulder for locating the flange. The disk stamping, with three holes pierced through it, is slipped over the shaft and silver wire is placed on top of this disk. Then, the wire, flange, and shaft are generously coated with flux, as shown at the bottom of the illustration, ready for brazing. If this part were produced in one piece in a lathe from round bar stock, a tremendous amount of stock would have to be removed and a disproportionate amount of machine time would be involved.

At the bottom in Fig. 4 are seen a steel tube, two stampings, a small machined plug, and two

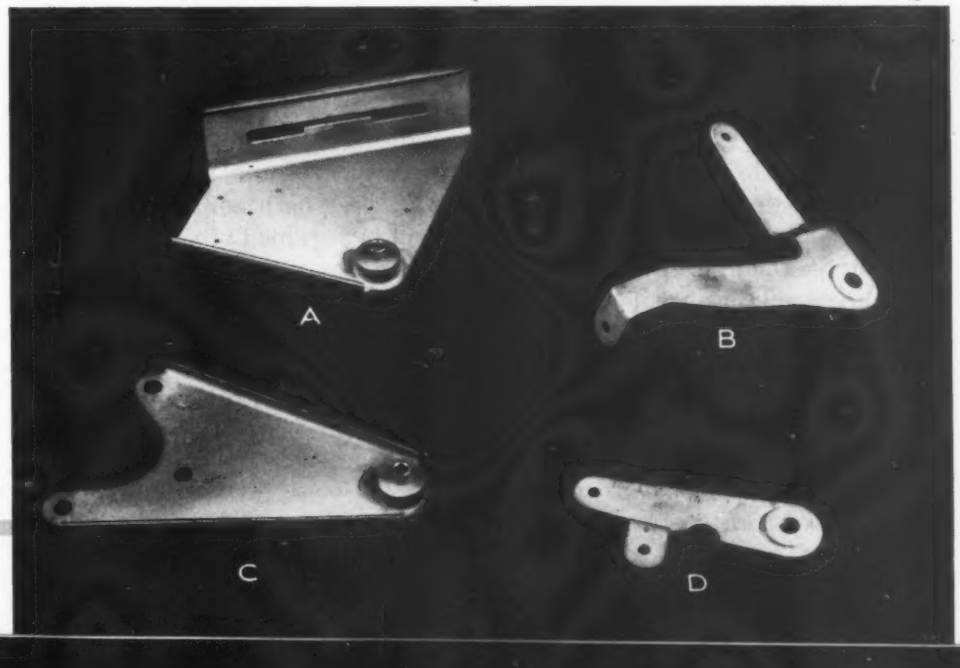


Fig. 1. Examples of Silver Brazed Work Consisting of Stampings to which Bosses have been Assembled by Brazing to Serve as Bearings

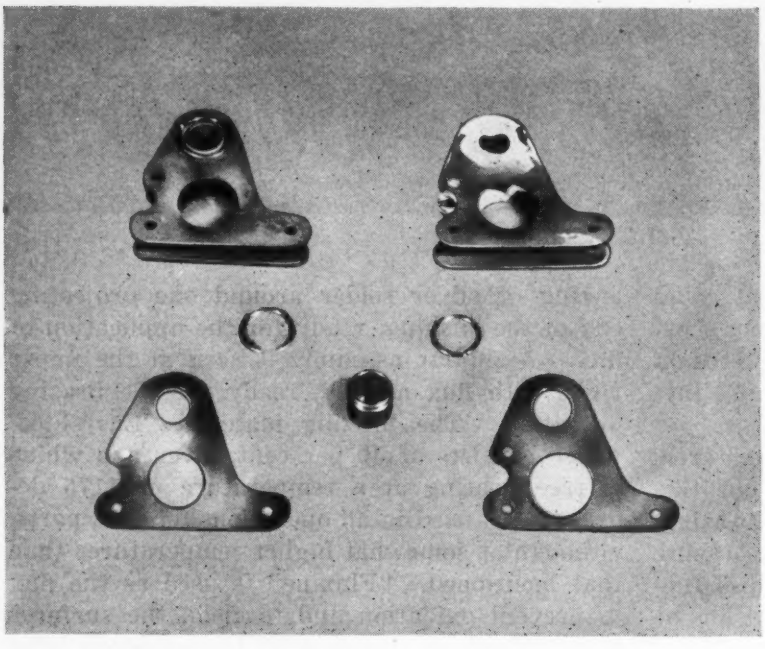


Fig. 2. (Left) Assembled and Disassembled Parts which are Made into Brackets by Silver Brazing. At the Upper Left, an Assembly is Seen with a Silver Brazing Ring in Place, and at the Upper Right an Assembly that has been Fluxed, Ready for Brazing

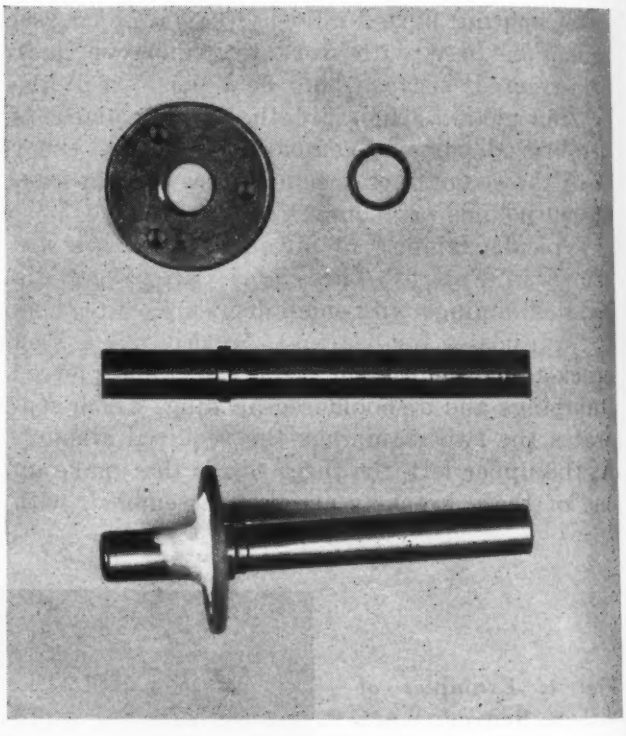
Fig. 3. (Below) Another Example of Silver Brazing, which Consists of Assembling a Comparatively Large Disk to a Previously Turned Shaft

rings of "Easy-Flo." These parts are joined by brazing to produce a rod with a jaw end. The finished part is seen at the top of the illustration, while in the center an assembly is illustrated with flux applied at the joints to be brazed. Assembling of the parts to be brazed together and brushing on of the flux are performed by girls. The assembling of the part shown in Fig. 2 is illustrated in Fig. 5.

Most of the silver brazing is performed on a Tocco 50-kilowatt induction heating machine, although operations are also performed in a gas-fired furnace. Hot dipping in molten "Easy-Flo" is resorted to in special instances when the part is especially adapted to this method of heating. The method of heating depends on the shape of the part, the volume to be made, and the production load on the various heating units.

An example of hot-dip silver brazing is shown in Fig. 6. Brackets such as seen at the left, which have small stampings spot-welded to them, are brazed by suspending one end to a depth of about 2 inches into a pot containing molten "Easy-Flo." Flux floats on top of the bath. The pot is heated to around 1400 degrees F.

The brackets are placed by the operator between simple clamps, which grip them securely through the action of coil springs. The brackets are left in the bath until they attain its temperature, whereupon they are removed with the aid of tongs and immediately immersed in a bath containing 10 per cent sodium hydroxide. This bath, which is maintained at a temperature of at least 190 degrees F., cleans off the flux, which has become hardened during brazing. All silver brazed parts, regardless of the manner in which they are heated in the brazing operation, go through this bath. When the parts are re-



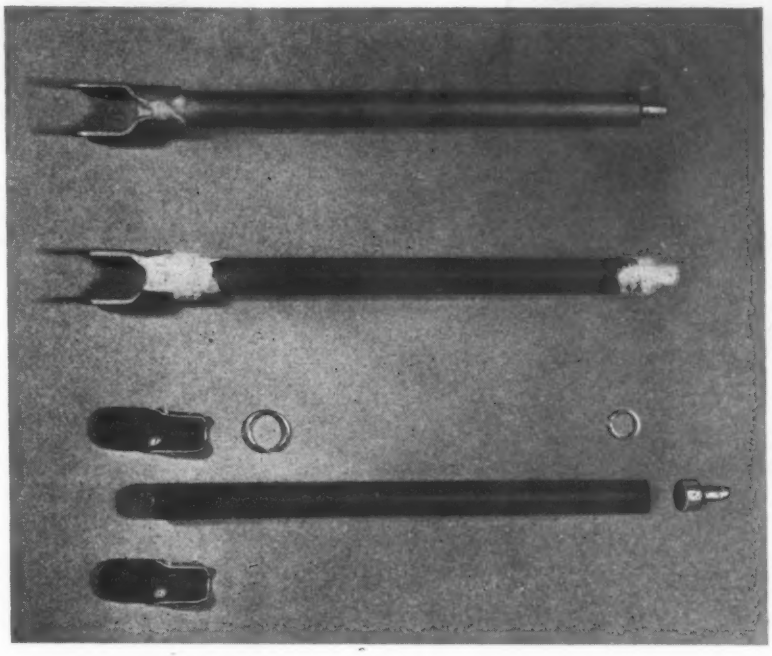


Fig. 4. A Steel Tube, Two Stampings, and a Machined Plug are Assembled by Means of Silver Brazing to Obtain a Shackle Rod

moved from the bath, they are generally free from flux, and any flux that may remain can be readily shaken off.

One end of the gas furnace used for brazing operations is illustrated in Fig. 7. Work is pushed through this furnace on trays. The fuel is air and gas, mixed together in the ratio of 10 to 1. The final furnace atmosphere contains 20 per cent carbon monoxide, 16 per cent hydrogen, and 64 per cent nitrogen. A temperature of 1400 degrees F. is customarily used in this furnace for silver brazing work. Parts being silver brazed generally remain in the heating chamber for about five to fifteen minutes and four times as long in the cooling chamber. They actually come out of the furnace cleaner than they were when put in, due to the controlled atmosphere.

One of the most interesting silver brazing jobs handled on the Tocco machine is the tail-wheel shock strut assembly seen at the lower left in Fig. 8. This assembly is made up from the six parts seen above it in the illustration, there being five silver brazed joints. Three of these joints may be observed in Fig. 9, which shows a cross-section through the cap end of the assembly.

The first step in brazing this assembly, which consists of joining the collar to the large-diameter outer tube or retainer, is performed with the set-up illustrated in Fig. 10. The collar rests on a flat arm of the work-holding fixture,

Fig. 5. Assembling and Fluxing Bracket Assemblies of the Type Shown in Fig. 2, Ready for a Brazing Operation

Fig. 6. (Left) Brackets with Stampings Spot-welded to Them for Locating Purposes are Silver Brazed by Dipping Them in Molten Silver Brazing Alloy

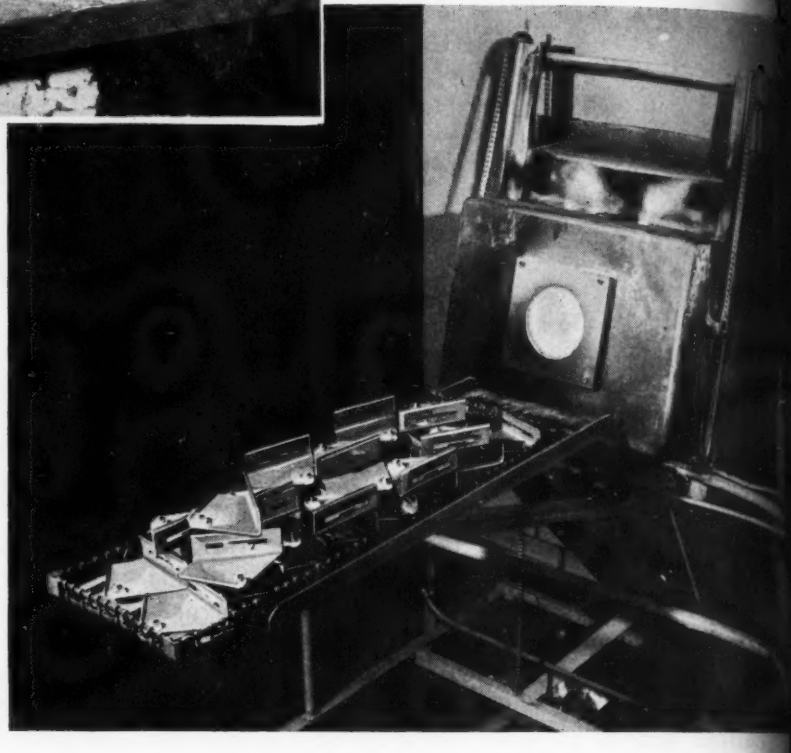


Fig. 7. (Right) Work that is Brazed in the Gas Furnace is Loaded on Trays for Convenient Handling

and the tube is inserted in the collar and held upright. The heating coil is located at a height corresponding to the top of the collar, for melting the ring of 1/16-inch diameter "Easy-Flo" which is placed on the collar. The end of the tube and the collar are heavily fluxed before being placed on the fixture. A temperature of from 1250 to 1300 degrees F. is employed for the brazing, as in all other operations on this induction heating machine.

Heat is applied for twenty-two seconds, and then a cooling period of approximately ten seconds is allowed for the silver brazing alloy to solidify before the part is removed from the fixture. From forty to forty-five parts can be induction brazed per hour, whereas when the pieces were brazed by a hand-manipulated gas flame, only eight parts were brazed hourly.

The next step in the assembly of the tail-wheel shock strut consists of brazing the washer seen at the extreme right in Fig. 8 to the end of the inner tube which is adjacent to the washer. This operation is performed with the set-up shown in Fig. 11, in which the heating coil is made with a shoulder or flange on the inside that provides a support for the lower end of the tube. The washer is first placed over a conical center on a stand below the coil which supports the washer by engaging its pierced hole. Both the end of the tube and the washer are heavily fluxed, and the flux is allowed to dry before the pieces are placed in the fixture. A ring of 3/32-inch diameter silver brazing wire is placed inside the tube when the parts are assembled.

A thirty-second heating cycle is used in this

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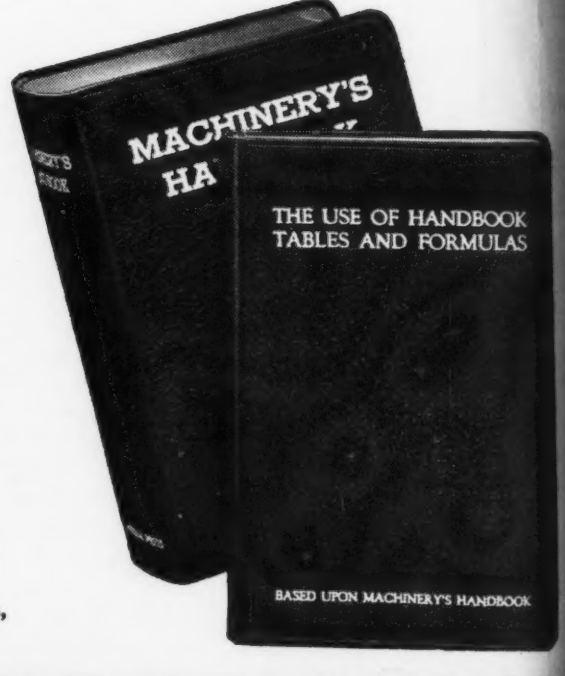

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operation, and a cooling period of about ten seconds. Thirty parts are induction brazed per hour, as against fifteen parts when brazing with a hand-manipulated gas flame.

The small tube seen next to the cap forging in Fig. 8 is next brazed in the position seen in the cross-section in Fig. 9. Flux is applied to the tube and to the hole in the cap where the tube fits, especially on the shoulder. The cap is placed for the operation in a jig or fixture so constructed that the hardened boss of the cap is immersed in water. This prevents the brazing heat from affecting the hardness of the part. After the cap is in position, the tube is set in place, and an induction heating cycle which lasts fifteen seconds is started. Additional heat is provided by a hand torch to bring the inserted tube up to the same temperature as the forged cap. Silver wire 3/32 inch in diameter is fed into the heated joint by hand when the parts have attained brazing temperature. Only a slight amount of brazing material is required, as the joint is readily filled and a good fillet of material is formed around the tube.

The final brazing on the tail-wheel shock strut assembly, which consists of welding the cap unit to the two tubular sub-assemblies, is performed on the Tocco machine with the fixture seen in Fig. 12. The two joints, which are clearly illustrated in Fig. 9, are 1 9/16 inches in diameter

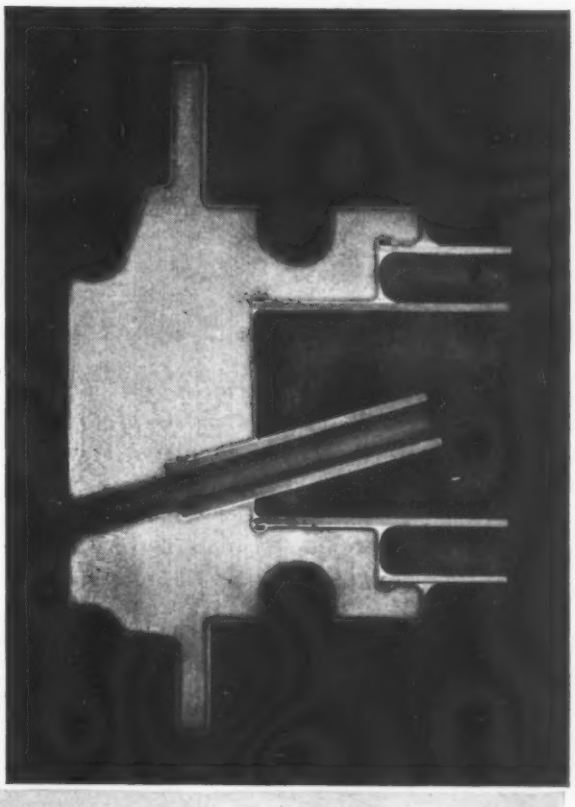
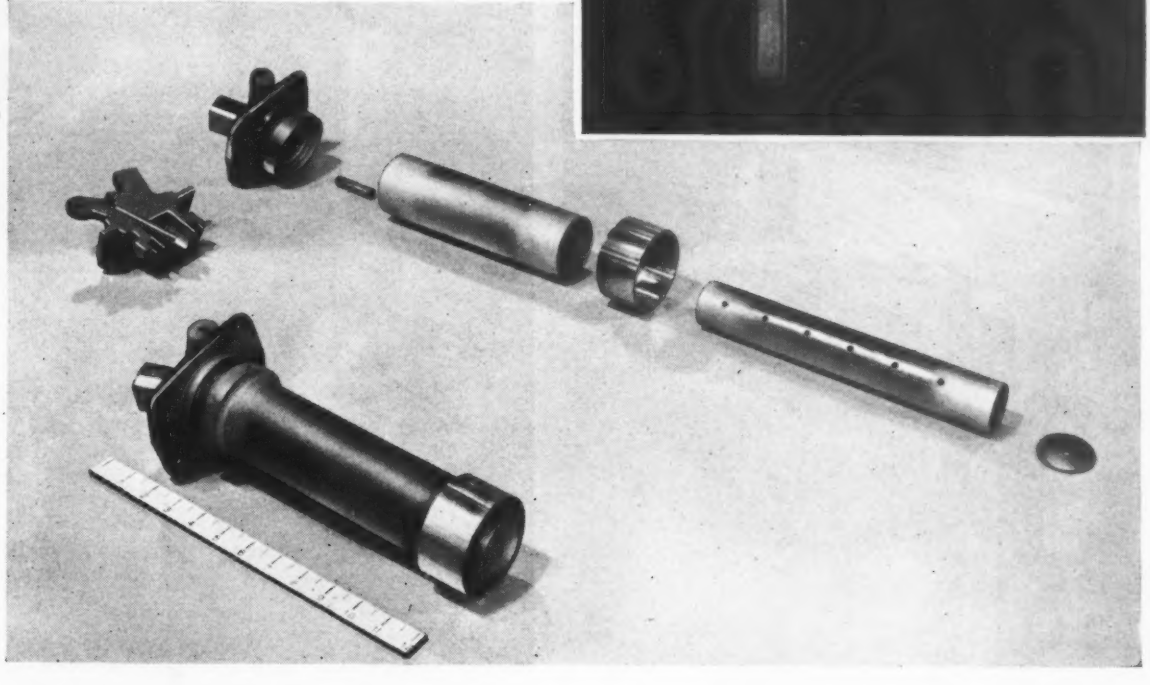


Fig. 8. (Below) Tail-wheel Shock Strut Assembly (at Lower Left), which is Made by Silver Brazing together the Six Parts Seen above the Assembled Part

Fig. 9. (Right) A Cross-section of the Cap Forging at One End of the Assembly in Fig. 8, which Shows the Manner of Brazing Three Tubes to This Forging



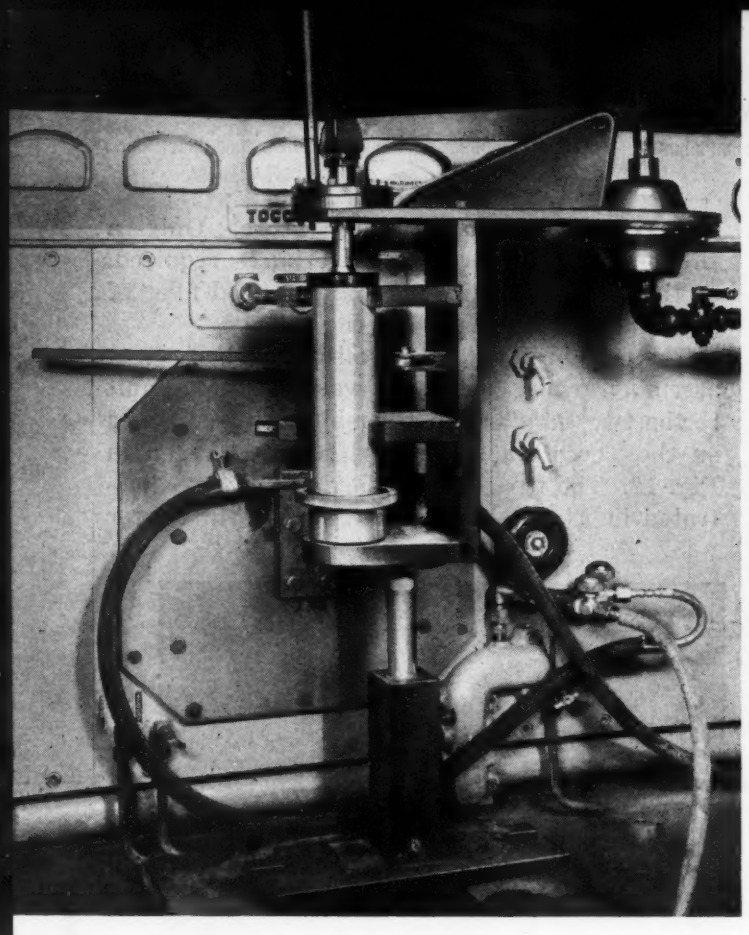


Fig. 10. (Above) First Operation on Tailwheel Shock Strut Assembly Consists of Brazing the Collar to the Larger-diameter Tube

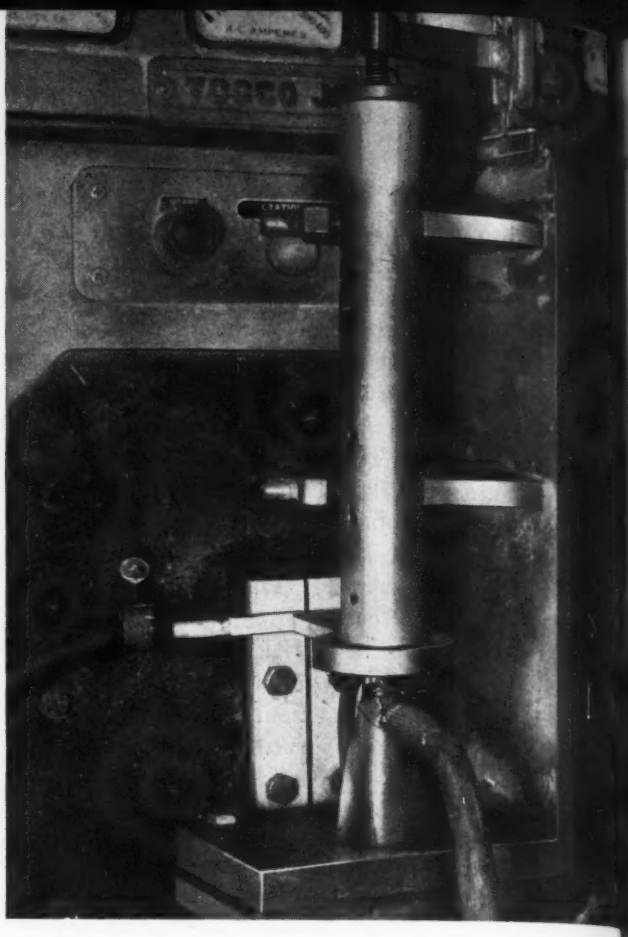


Fig. 11. (Above) Second Operation on Shock Strut Assembly Consists of Brazing the Washer in One End of the Smaller-diameter Tube

Fig. 12. (Below) Final Brazing Operation on Shock Strut Assembly Consists of Brazing the Outer and Inner Tubes to the Cap Forging

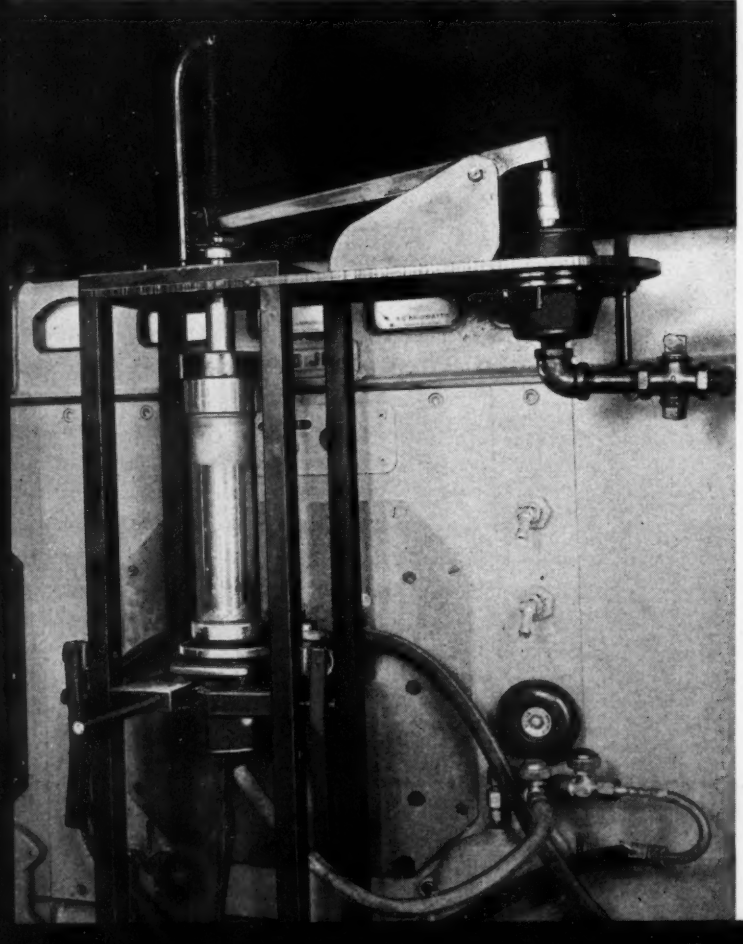


Fig. 13. (Below) All of the Silver Brazed Work is Immersed in a Caustic Soda Bath for Removal of the Hardened Flux

by 3/4 inch long and 2 1/4 inches in diameter by 1/4 inch long. A ring of 3/32-inch silver wire is first dropped into the center of the cap and then the two tubes to be brazed are placed in position, a ring of wire having also been placed around the end of the inner tube.

As the two tubes are started into their respective recesses in the cap, air is admitted into a diaphragm to operate a piston. Both tubes are positioned for height by this piston, which actuates a plunger at the top of the fixture. An induction heating cycle of fifteen seconds, followed by a cooling period of thirty seconds, results in a production of eight parts per hour as against three parts when hand brazing was employed.

At the Tocco machine, these tail-wheel shock strut assemblies are loaded into a basket with the cap downward. The loaded baskets are then transferred to the tank illustrated in Fig. 13 where they are immersed in a 15 per cent caustic soda bath. The parts are held in this bath for at least one hour, and usually are allowed to soak overnight. The parts are then reloaded into another basket, again with the caps downward, and washed in fresh water. They are finally removed, one at a time, emptied of water, and blown dry with compressed air.

From the foregoing examples, it will be obvious that brazing by induction heating results in appreciable increases in the rate of production over hand torch brazing. On small parts, the same advantage exists. For example, the part seen at *C* in Fig. 1 is brazed on the induction heating machine at the rate of 100 parts per hour, as against 50 parts by hand gas brazing. Production figures for the two methods are similar for the other pieces in Fig. 1.

Brazing on part *C* is performed on the Tocco machine with a simple set-up, such as illustrated in Fig. 14. The end of the stamping where brazing is performed has an air clearance between it and the heating coil. The built-up fixture has a steel base, wood spacer block, and Transite top, on which the part is supported. The construction of this fixture is clearly shown in Fig. 15. It is also used for brazing the parts seen at *A*, *B*, and *D* in Fig. 1. Incidentally, the slot that extends toward the front of the fixture was provided to accommodate one of the bent arms on part *B*.

(Concluded on page 201)

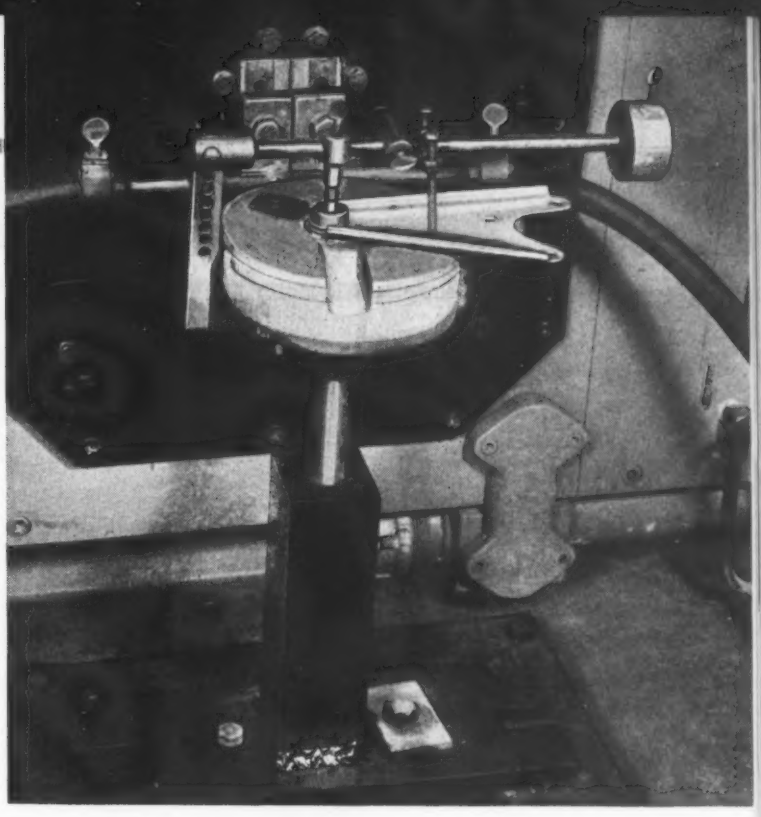
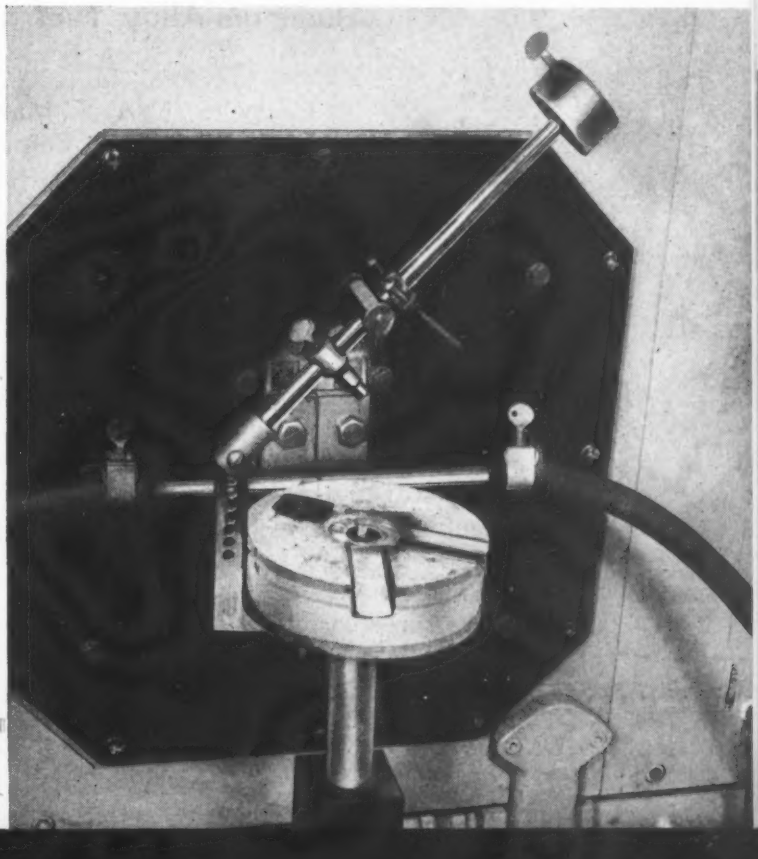


Fig. 14. In Silver Brazing the Stampings Seen in Fig. 1 on the Induction Heating Machine, a Simple Fixture Built up of Steel, Wood, and Transite is Used

Fig. 15. View of the Built-up Fixture Seen on the Induction Heating Machine in Fig. 14 with the Work Removed, so as to Clearly Show the Simple Construction of the Fixture



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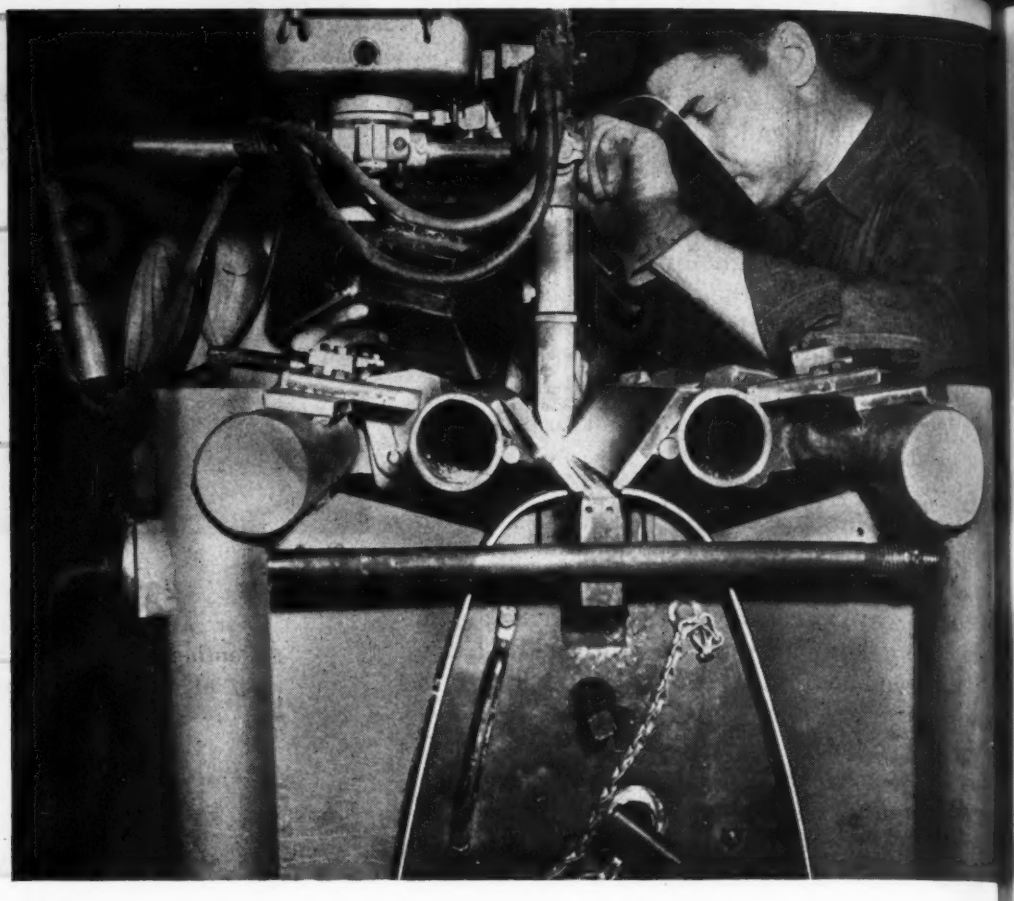


How Engineers of the Curtiss-Wright Corporation Solved the Problem of Designing and Fabricating Leakproof Aluminum-Alloy Fuel Tanks for Transport Planes

By W. S. EVANS, Materials and Process Engineer
Curtiss-Wright Corporation, Airplane Division
St. Louis, Mo.

EVERY manufacturer of transport aircraft is concerned with the problem of designing and fabricating fuel tanks that will meet all structural and operational requirements, and at the same time be leakproof. It takes little imagination to visualize the hazards of flying an airplane with leaking wing fuel tanks. To eliminate such hazards, the Curtiss-Wright Corporation spent considerable time on the development of a new fuel tank for the C-46 Commando transport planes.

There are three basic types of fuel tanks, all of which have been used by this corporation in recent years. These are: (1) Integral tanks, in which structural members such as ribs and wing skins are sealed to make a compartment for fuel; (2) riveted tanks, which are removable and are assembled by riveting sealed seams; and (3) welded tanks, in which all seams are closed by welding. Curtiss-Wright experience indicates that, while any of these tanks, properly designed, will meet structural requirements, it is very difficult to produce leakproof tanks when assembly is accomplished by riveting. This difficulty was instrumental in the adoption of welded fuel tanks for the Commando.

# of Aircraft Fuel Tanks

The conversion from a riveted to a welded tank involves a major redesign and a comprehensive test program. Testing is necessary to insure a design capable of withstanding service conditions for extended periods. The most rigorous test consists of subjecting a partly filled tank to vibration for twenty-five hours.

While certain engineering principles and experience can be applied in tank design, a satisfactory tank is usually evolved by the trial-and-error method. The customary procedure is to design a tank that meets structural and shape requirements and has the most feasible interior reinforcement. This design is then submitted to static and vibration tests and subsequently examined for failures. Zones that have failed are analyzed, and modifications made to improve the resistance of the tank to vibration, after which a new test is run. This procedure is continued until a successful design is obtained. The initial design and all design changes are checked with the production personnel to assure that the final tank can be readily fabricated at reasonable cost.

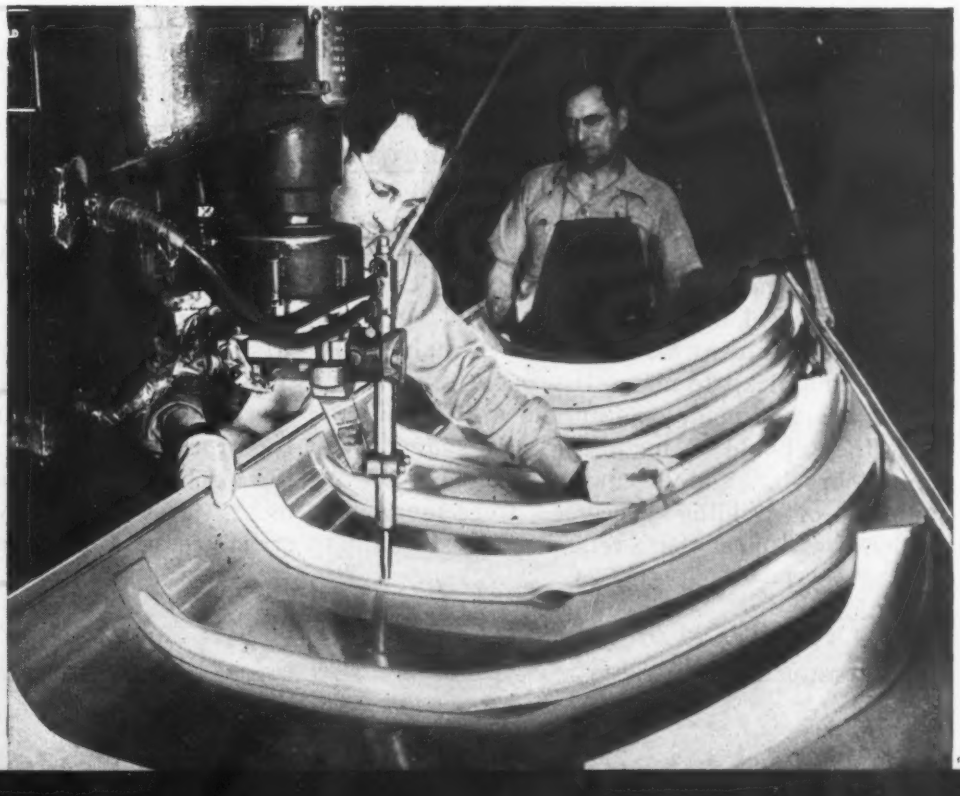
A program of the type described resulted in the tank which is shown unassembled in Fig. 2. The simplicity of this design is apparent. The tank is made in four major parts—the two semicircular shells and the two ends. Hat-section chordwise stiffeners are spot-welded to each half shell to increase the rigidity. T-section angles are also spot-welded to the half shells. After assembly of the two half shells by welding, the bulkheads are riveted to the T-section angles. This bulkhead design was accepted as a compromise after efforts to spot-weld solid bulkheads into place proved unsuccessful.

Fittings, the sump, the inlet, and bonding tabs are welded on after assembly. All external seams and attachments on this tank are made by welding. The fabrication and assembly of this fuel tank represent considerable engineering effort, as will be understood from the following description.

Fabricating the Leakproof Aluminum Fuel Tanks

The fabrication of the detail parts follows standard practice in forming aluminum. The half shells are formed from 0.081-inch thick 52S-1/2H aluminum alloy to sheet-metal tolerances by employing rolls and a press brake. The tank ends are drawn from 0.081-inch thick 52S-O

Fig. 1. Spot-welding Hat-section Stiffeners to One of the Two Semicircular Shells which, together with the Two Ends, Make up a Fuel Tank



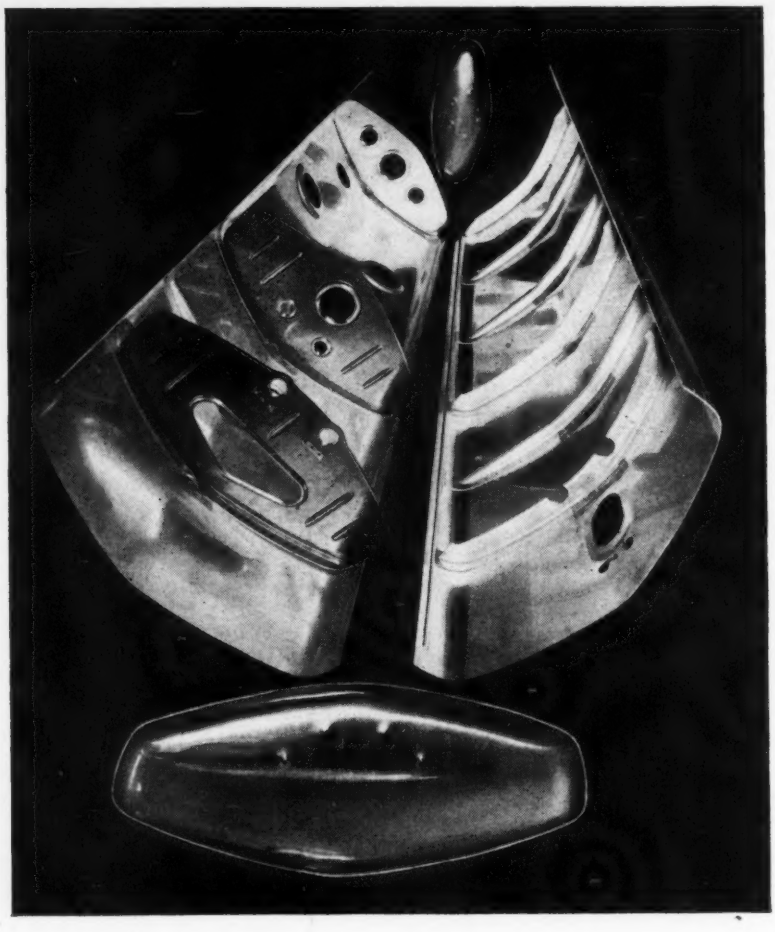


Fig. 2. Details of the Leakproof Fuel Tank for Curtiss Commandos, which is Designed for Complete Assembly by Welding, the Long Horizontal Seams being Welded by the Heliarc Process, the Bulkheads by Spot-welding, and the Ends by Oxy-hydrogen Gas-welding

aluminum alloy on a hydro-press, and the hat sections, which are made from the same material, are formed under a drop-hammer.

The first step in assembling the detail parts is the attachment of the hat sections and T-sections to the half shell by spot-welding. Stored-energy welders, certified to weld two pieces of 0.081-inch thick 52S-O aluminum alloy, are used, as shown in Fig. 1. Cleaning prior to welding is accomplished by immersing the detail parts in an acid solution. After spot-welding, the completed half shells are ready to be welded together.

Early in the designing stage of this tank, it was recognized that the two 10-foot long horizontal weld seams which assemble the half shells would be difficult to make. It was necessary that these welds be made rapidly and uniformly and that they should be metallurgically sound, free from porosity, and of maximum strength. A number of welding processes were available which would meet these requirements, including carbon arc, automatic gas, and controlled-atmosphere arc welding.

Previous experience coupled with a study of welding conditions led to the adoption of the controlled-atmosphere arc-welding process for these long horizontal welds. This process is commonly called "Heliarc" welding, the name being copyrighted by Northrop Aircraft, Inc. It consists of introducing an inert gas, usually helium, into the area surrounding the arc, which prevents the atmosphere from reaching the molten metal during welding.

For some time, the Curtiss-Wright plant had been making short, relatively simple welds with this process on production parts. These welds were made semi-automatically with the equipment shown in Fig. 3, in which *A* is the welding torch containing the tungsten electrode and the tube for helium flow; *B*, the crank for moving the torch; and *C*, the control for vertical adjustment. The uniformity and consistently sound structure of welds made with this equipment

Fig. 3. Simple Heliarc Welding Equipment, the Performance of which Led to the Development of Much Larger Machines for Applying the Same Process in the Assembly of Fuel Tanks

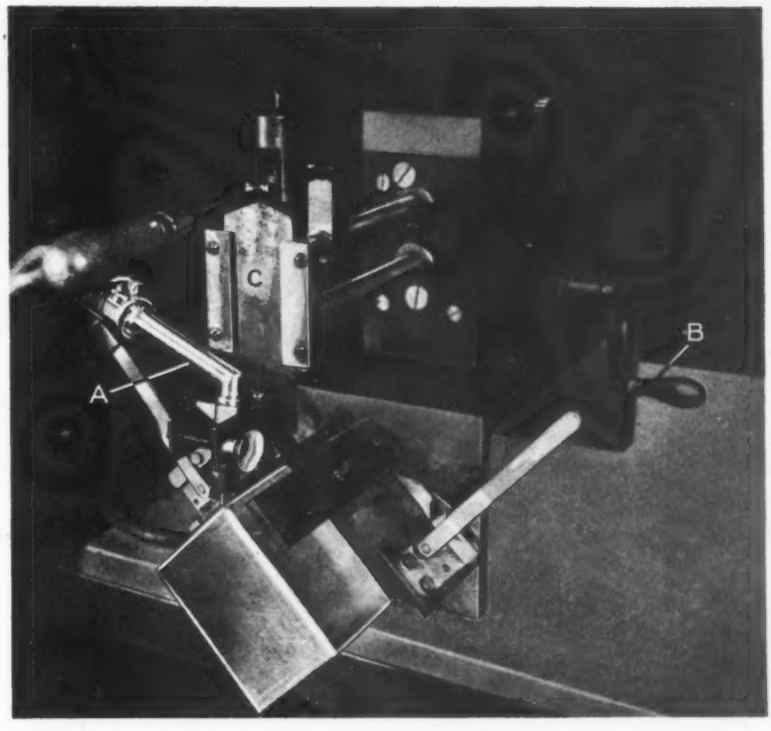
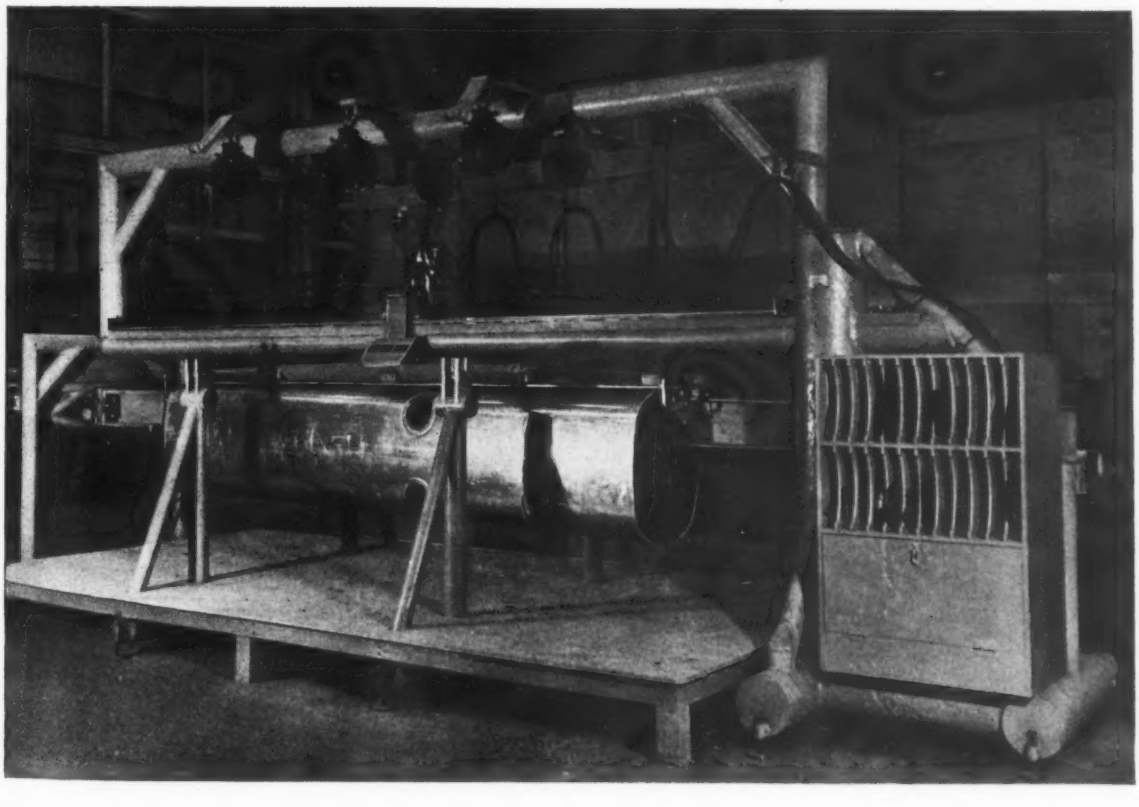


Fig. 4. Experimental Jig Originally Devised for the Heliarc Welding of the Two Half Shells of the Fuel Tanks, which Led to Development of a Jig Suitable for High-production Work



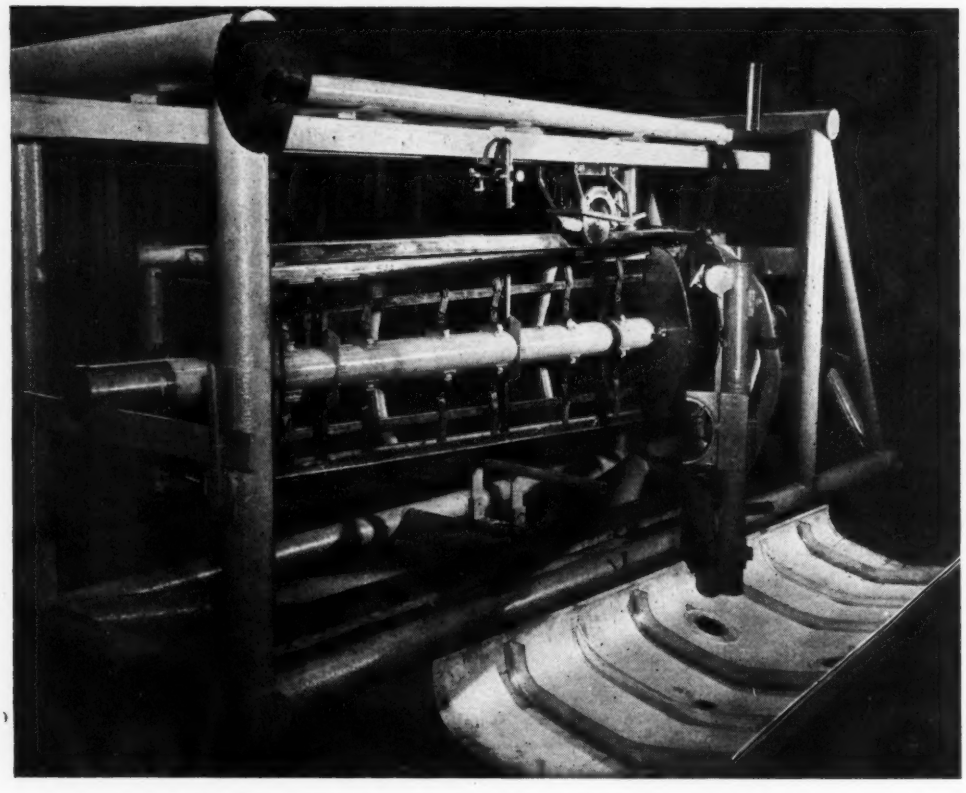


Fig. 5. Final Type of Jig Developed for the Heliarc Welding of the Long Seams of the Fuel Tanks, which Embodies Many Improvements over the Experimental Jig

indicated that a semi-automatic welding head could be used for production operations.

One of the initial steps in the program was the design and construction of an experimental jig, based on the knowledge possessed at that time. This jig is seen in Fig. 4 with two half shells in place for welding. The jig has a grooved back-up bar, on which the half shells are placed. Two tie-down bars running the length of the 10-foot long seam and mounted on counterbalanced hoists, were used to hold the shells rigidly against the back-up bar. The Heliarc welding head was mounted above the seam on a level track and moved forward on a line parallel with the seam.

While this jig was suitable for the assembly of experimental tanks, it was not acceptable for production. The hold-down bars, which were attached only at the ends of the seam, tended to rise in the middle. This relieved the clamping pressure on the skins and allowed them to move, which resulted in poor welds. It was necessary to hand-fit skins and carefully adjust the gap between shells. The welding torch used, which was similar to that shown in Fig. 3, was too small. It overheated and did not permit the flow of sufficient helium to effectively shield the arc from the atmosphere. This jig, however, proved that this general method of assembly was entirely practical.

With this background, engineers and tool planners collaborated on the design of the production jig shown in Fig. 5. The general arrangement is the same as that of the experimental jig, but there are many improvements and modifications. To overcome the trouble with bowed hold-down bars, a tubular hinged structure was designed, which serves the dual purpose of locating the half shells in position and rigidly supporting the hold-down bars. Adjustments to clamp skins firmly are accomplished by raising the back-up bar with screw jacks until the sheet is pressed tightly against the hold-down bars.

In order to obtain a uniform gap between the sheets, a saw is mounted on a level track, as

shown in the close-up view, Fig. 6, so that its blade is directly above the groove in the back-up bar. After the half shells have been clamped in the jig, the saw trims the sheets, leaving an 0.081-inch wide gap. In place of the ordinary practice of adding welding rod, a 1/4- by 0.081-inch filler strip of 52S-1/2H material is placed vertically in this gap. The method described effectively handles the problem of adding a uniform amount of filler metal to the weld, and at the same time, eliminates the necessity for careful forming of skins to impractical tolerances.

Since the welding torch used for the experimental work was too light for production, it was redesigned as shown in Fig. 7. The 1/4-inch tungsten electrode can be seen jutting out from the large tube through which the helium flows. A voltmeter and ammeter, together with the welding machine voltage control knob, are mounted on the welding head to enable the operator to make heat adjustments without leaving the jig. The two rollers, barely visible at the bottom of the photograph, were added to hold the filler strip firmly in place.

The jig was so designed that it can be rotated 180 degrees, thus making it possible to complete both welds without removing the tank from the jig. After the completion of all welding operations, the end gate can be opened and the assembled tank shell removed. The tank is then ready for installation of the bulkheads and attachment of the ends.

Effect of Variables in Heliarc Welding

With production jigs ready for use, it was necessary to establish the correct Heliarc welding technique. Tests were conducted, in which various fluxes, speeds, current settings, and amounts of helium flow were used. Metallurgical and physical tests were made to determine the effect of these variables. In Fig. 9, which shows a photomicrograph of a typical fusion zone between the weld metal and the parent metal, the uniformity of the weld can be noted.

Each variable was considered individually. Tests with various commercially available fluxes were made to determine the type and amount that would produce the best results. It developed that a limited application of a flux composed of one part Alcoa No. 22 and one part Alcoa No. 33, mixed to a watery consistency with ethylacetate or carbon tetrachloride (preferably the latter) produced the soundest weld.

Adjustment of the helium flow proved to be relatively critical. Excessive flow has a chilling effect on the weld, while insufficient flow allows oxygen from the air to get into the weld and

Fig. 6. Close-up View of the Saw Provided on the Production Jig for Trimming the Half Shells of Fuel Tanks prior to Heliarc Welding to Insure a Uniform Gap between Them

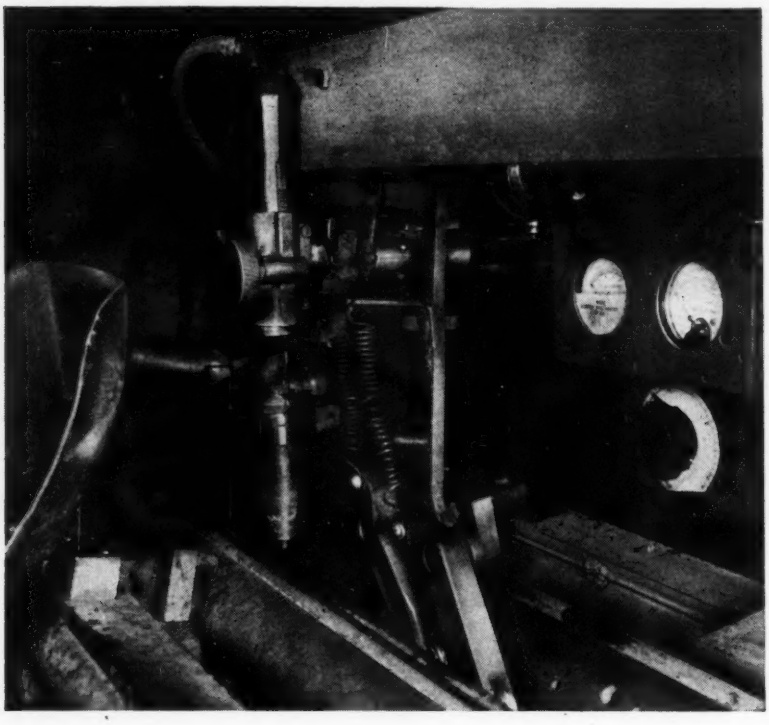


Fig. 7. Close-up View of Heliarc Welding Torch that is Provided on the Production Tank Assembly Jig Shown in Fig. 5

reduces the quality. With the type of nozzle used, it was determined that 8 liters per minute, measured with a therapy type flow meter, produced a satisfactory atmosphere.

The speed of the welding head travel could be varied, according to welding conditions, from very slow to 2 feet per minute. At low speeds, a wide bead was formed which extended under the hold-down bars. Speeds approaching maximum gave poor penetration and a very rough weld bead. Satisfactory results were obtained at a welding speed of approximately 1 foot per minute.

It was found that the manually controlled arc length should be held as short as possible, approximately 1/16 inch. A long arc proved erratic, due to magnetic blow caused by the proximity of the steel hold-down bars. Arc length is usually the only adjustment the operator has to make during the welding of a seam. In normal welding, the arc voltage is approximately 18 volts, and the amperage about 123 amperes. It is possible to change these settings by means of the control knob on the welding head.

When all the variables mentioned are properly adjusted, the weld is remarkably good. The heading illustration shows an operation in progress. The welding head moves forward at the rate of about 1 foot per minute along the 10-foot bead being welded. Note the back-up bar in place on the under side of the work. Fig. 8 shows the full-length welded seam on a completed tank. There is unusual smoothness and consistency of the weld bead.

In order to maintain this weld quality, it is necessary to watch for certain sources of production trouble. A prime source of bad welds is poor jig alignment. It is essential that the saw be directly in line with the groove in the back-up bar. Otherwise, the filler rod gap will be off center, resulting in an unbalanced and under-cut weld. Under normal plant operating conditions, jigs must be realigned periodically.

In this particular welding operation, the dimensions of the groove in the back-up bar are critical. The contour used has a 1/8-inch radius, is 0.060 inch deep, and has the corners broken by a 0.020-inch radius. An experimental change of this contour resulted in pitting and cratering of the weld, as shown in Fig. 10. The amount of flux added is also critical, as excessive flux produces a porous weld.

The attachment of the ends and various castings to the fuel tank is done by means of oxy-hydrogen gas welding, although recently tests have been made with a new welding process for attaching the ends. This process, called "Multi-

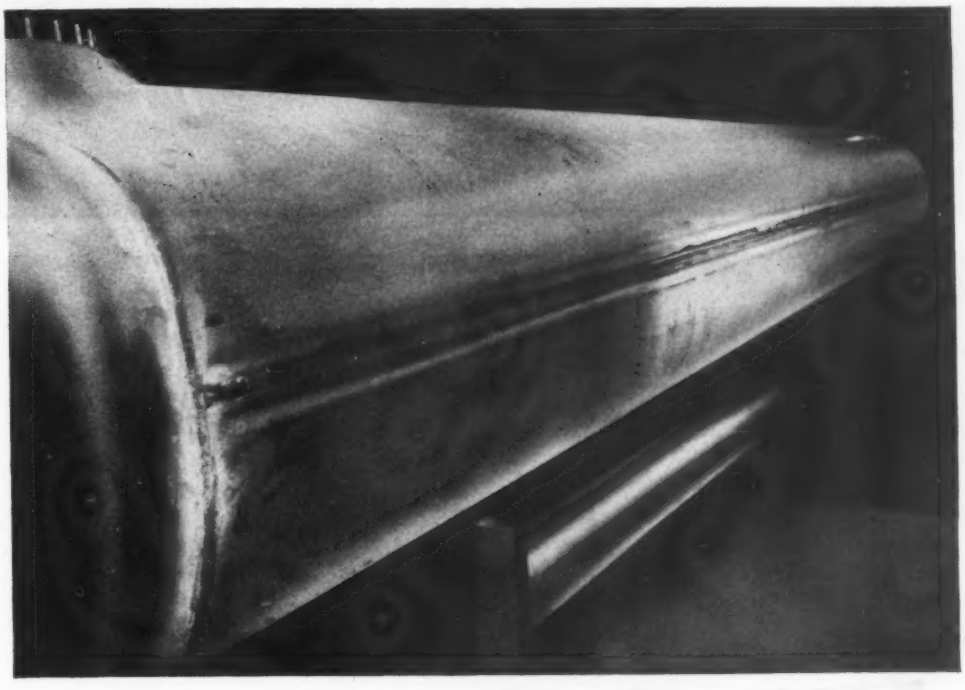


Fig. 8. Completely Welded Leakproof Aluminum Fuel Tank. The Illustration Shows Especially One of the Long Horizontal Heliarc Welded Seams

arc" welding, was developed by the Curtiss-Wright Research Laboratory.

By following the procedure outlined, the Heliarc welding process has proved a highly satisfactory method for semi-automatic welding in quantity production. Expanded utilization of controlled-atmosphere welding can be forecast for many welded aluminum aircraft parts.

Fig. 9. Photomicrograph of a Typical Fusion Joint between the Weld Metal and Parent Metal, Indicating the Uniformity of the Weld Made by Employing the Heliarc Process

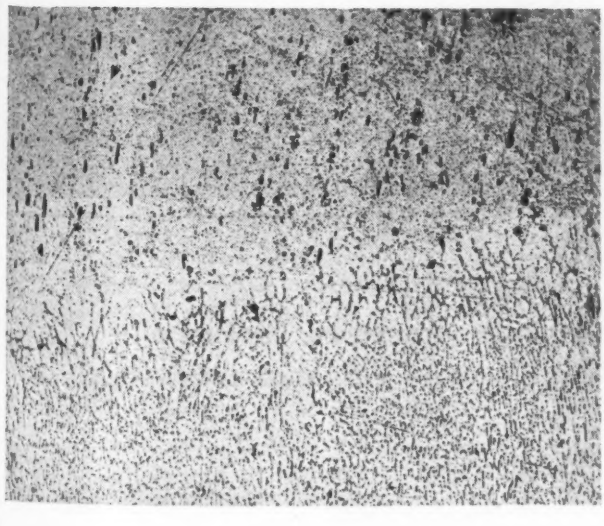
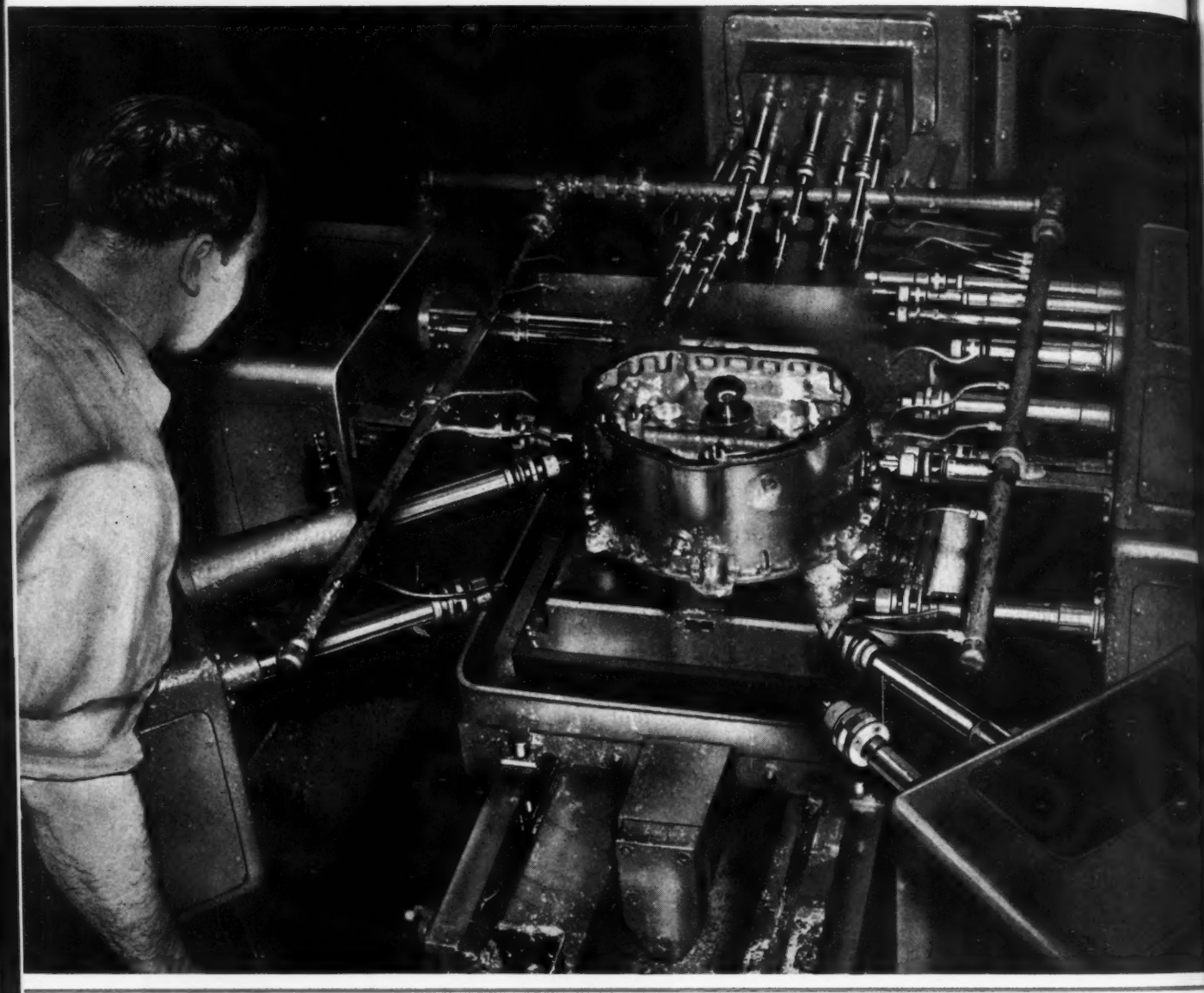


Fig. 10. Illustration Showing a Pitted Weld that was Completed by Using a Groove of Improper Contour in the Back-up Bar of the Heliarc Welding Production Jig

Multiple Tapping of



How Thoughtful Consideration of a Troublesome Problem Effected Large Economies in Aircraft Engine Manufacture

By CHARLES O. HERB

Magnesium and Aluminum

THE specification of a Class 3 fit for practically all tapped holes in the manufacture of aircraft engines has presented many serious shop problems. It has been general practice to both rough- and finish-tap the threaded holes in aircraft engine parts one at a time, and in many instances, to follow up with a hand tapping operation. Obviously, this is a costly procedure, not only from the standpoint of the time consumed, but also because of the monetary investment tied up in the great number of taps required by a plant turning out aircraft engines on a wartime production schedule.

The major difficulties have occurred in tapping the aluminum and magnesium castings and forgings used in aircraft engine construction. When these metals are tapped with taps of conventional design, there is considerable danger of the threads being torn, and it is because of this likelihood that roughing and finishing operations are widely employed and that holes are tapped one at a time instead of in multiple.

With a view to reducing tapping costs on aluminum and magnesium parts, expediting production, and reducing scrap work, engineers and production men at the Melrose Park Plant of the Buick Motor Division of the General Motors Corporation made an extensive study of the problem and found a practical solution. It was ascertained that tearing of threads in tapping magnesium and aluminum was mainly due to forcing the tap in cutting or in backing out.

Furthermore, it was found that this tearing resulted from wedging of the stringy chips of magnesium and aluminum between the newly formed threads and the relieved portion of the lands on the tap threads by burrs in the flutes and by rough-ground flutes. By simply establishing a shop rule that only taps with the thread ground concentric with the tap body and shank could be used, and by grinding the tap flutes with a hand wheel, the tearing of threads on magnesium and aluminum parts has been eliminated in this plant.

In order to tap threads to meet the specification of Class 3 fits, it was decided that each tap spindle in multiple set-ups would need to have its individual lead-screw and a fully enclosing lead-nut. Every multiple set-up now in use in this plant has been devised on that principle. Even though a cluster of tapping spindles is driven from a common source, the various spindles are fed by individual lead-screws. In some instances, they are fed at different rates, as

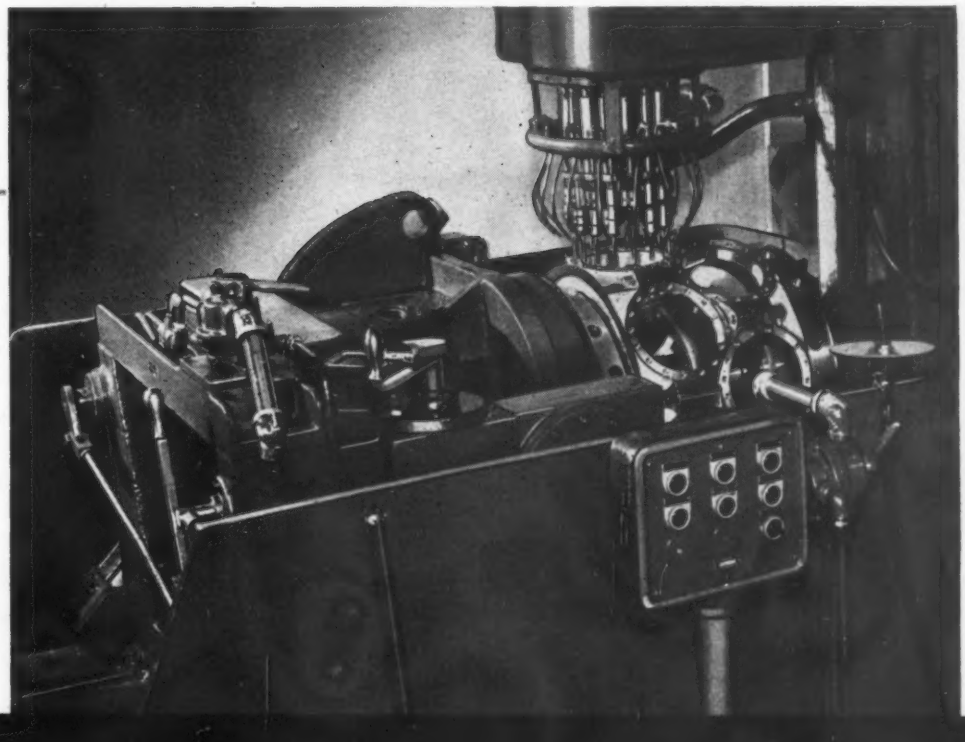
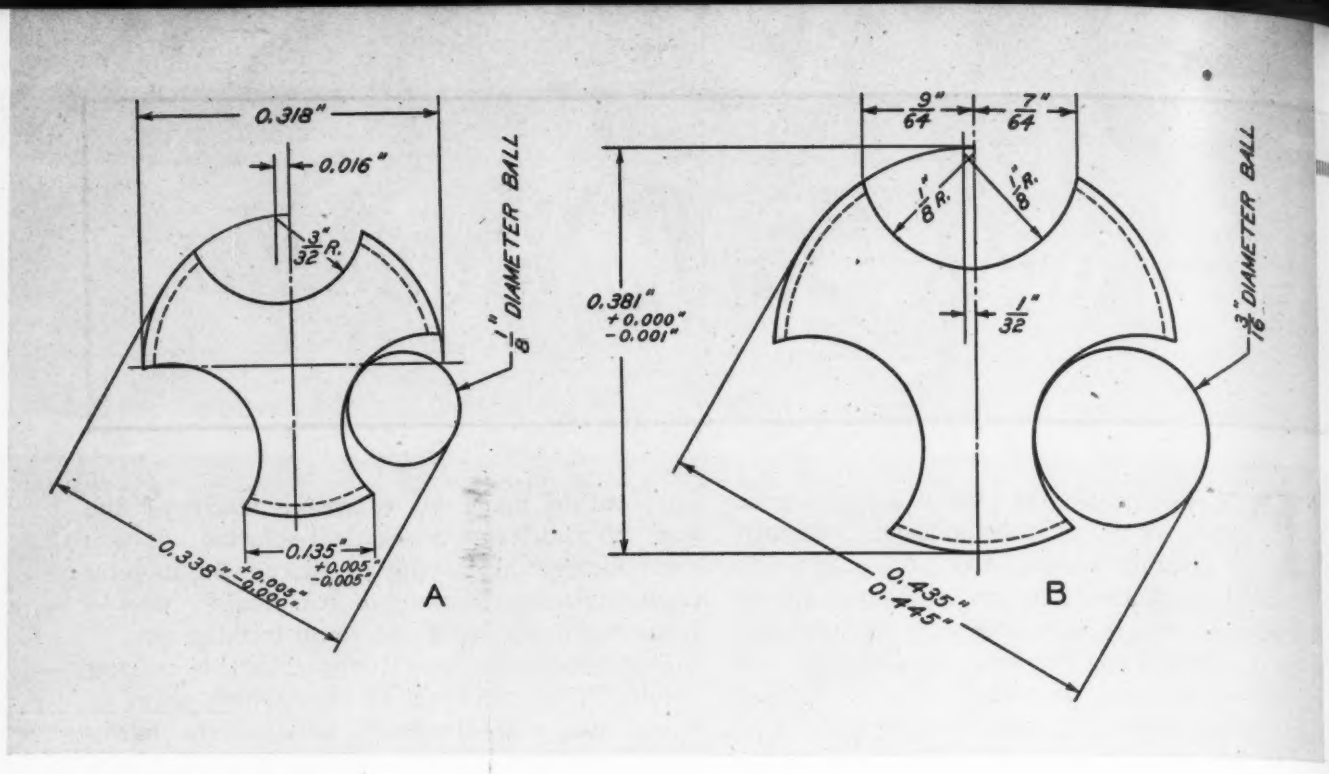
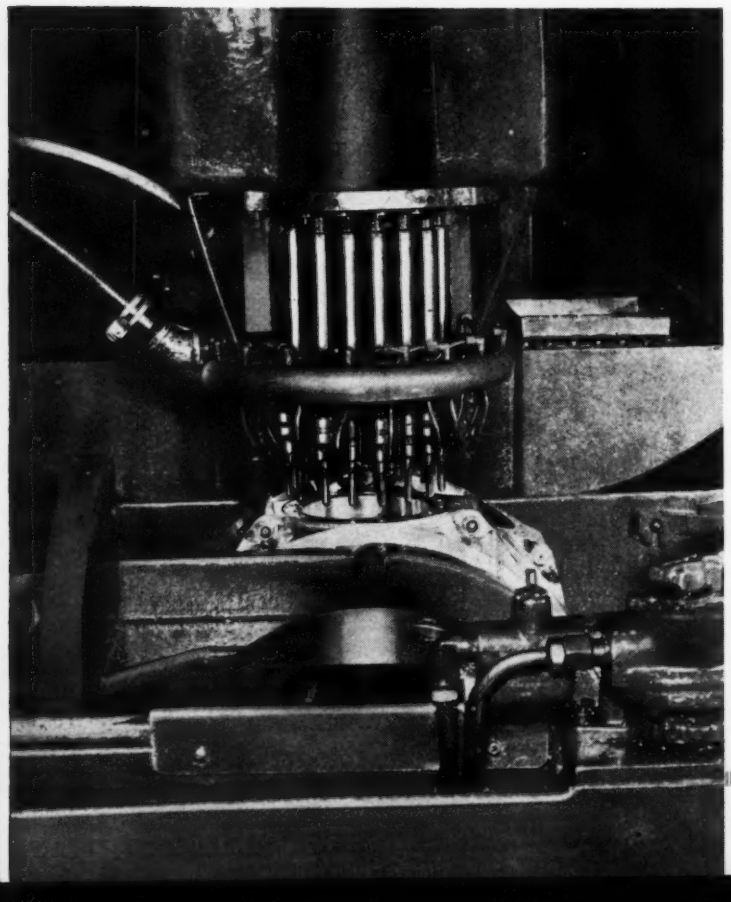


Fig. 1. The Sixteen Hold-down Stud Holes on Each Cylinder Pad on Crankcase Sections are Tapped Simultaneously with the Equipment Shown. All of the Fourteen Cylinder Pads are Tapped in One Operation by Indexing the Work between Downward Movements of the Multiple-spindle Head



necessitated by the pitch of the thread being tapped. They are also revolved at different speeds in instances where one or more holes are located considerably lower on the work than the remaining holes in the group, with the result that some of the tapping spindles must be fed to an appreciably greater depth.

Another factor important to the successful tapping of magnesium and aluminum is the use of full floating holders or chucks, so that the individual taps will be self-centering in the holes being threaded.



Because of the nature of magnesium and aluminum, it is desirable to grind the tap cutting edges with somewhat more hook than is generally provided on taps intended for steel and cast iron. The desirable amount of hook varies with tap wear, which, in turn, necessitates changing the hook to suit size requirements. Diagram *A*, Fig. 2, indicates the method of determining the amount of hook that should be given to a 5/16-inch tap of 18 threads per inch in regrinding. Likewise, diagram *B* illustrates the method of determining the amount of hook that should be provided on a 3/8-inch tap with 16 threads per inch. The hook on smaller or larger taps than those mentioned should be in the same proportion. All taps are of precision ground commercial types, and have either three or four straight flutes.

With a full understanding of the principles involved in tapping magnesium and aluminum as a result of the investigation, Buick engineers, in conjunction with machine tool builders, were able to establish all tapping operations in the plant on a multiple basis. This has paid large dividends in saved time, reduced costs, and the

Fig. 2. (Above) Diagrams Showing Method of Grinding the Flutes of Taps for Use on Magnesium and Aluminum

Fig. 3. (Left) Close-up View of the Cluster of Taps Provided on Machine Illustrated in Fig. 1

elimination of defective work due to improperly tapped holes. If this program had not been put through, it would probably have been impossible to have purchased enough taps during the critical tool shortage to have enabled the shop to meet production schedules. Some of the more unusual multiple tapping set-ups are described in the following.

Sixteen holes of 3/8-inch diameter, 16 threads per inch, are simultaneously tapped in the cylinder pads of crankcase sections to receive the hold-down studs. This operation is performed by means of set-ups of the type illustrated in Fig. 1. As there are fourteen of these cylinder pads on a crankcase section, the machine is provided with a fixture that can be indexed and also moved in and out under the tapping head to permit the tapping of the 224 hold-down stud holes in one set-up of a crankcase section. All the holes are now being tapped in 0.435 man-hour, as against 1.980 man-hours when the holes were individually tapped. This represents a saving in time of approximately 75 per cent, and requires the use of only one multiple-spindle machine instead of four single-spindle tapping machines.

The crankcase is loaded on the fixture by lowering it over a vertical post and locking it in position. Then, by means of air pressure, the work and fixture are tilted into the horizontal position illustrated and locked. Then the slide on which the fixture is carried, is moved back toward the machine column in order to bring the rear bank of cylinder pads under the tapping head. This movement is effected by an air cylinder controlled by a solenoid switch. A limit switch insures proper location of the fixture beneath the tapping head.

In operation, the tapping head is first lowered to a positive stop, at which point the tapping spindles start to revolve and feed downward under the control of their individual lead-screws and nuts. When the taps have been fed to their full depth, a limit switch is operated to reverse the rotation of the taps and withdraw them. The feed motor then stops and the tapping head rises to its starting position. This sequence is repeated for each of the seven rear cylinder pads on a crankcase section. Between the tapping steps, the operator indexes the work.

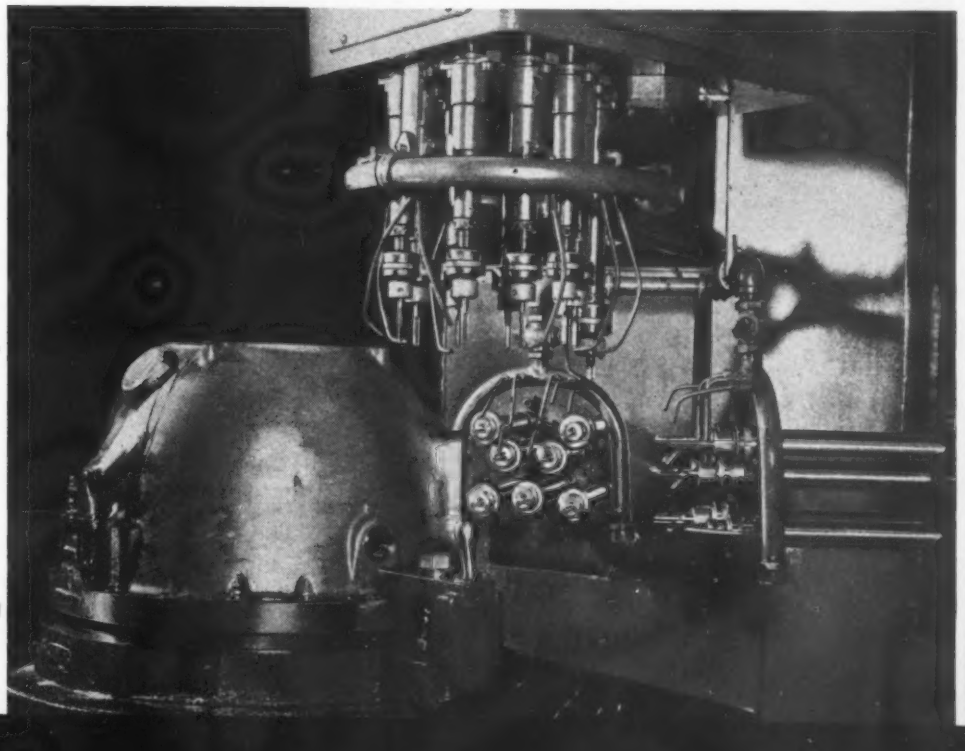
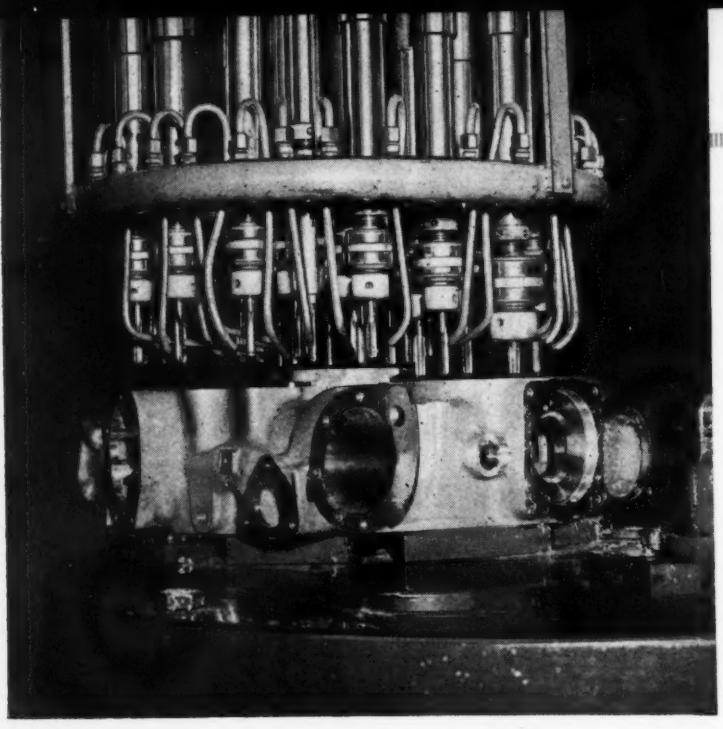


Fig. 4. (Above) Tapping Twenty-three Holes Simultaneously in the Magnesium Nose Section for Aircraft Engines, All of the Threads being Machined to a Class 3 Fit

Fig. 5. (Right) Another View of the Tapping Equipment on the Machine in Fig. 4, Showing the Arrangement of the Three Groups of Tapping Spindles



When all the cylinder pads in the rear bank have been tapped, the fixture is again actuated by air pressure to bring the front bank of cylinder pads in line with the tapping head. The same procedure is followed in tapping the front bank of pads as in tapping the rear bank. When all fourteen pads have been tapped, the work-fixture, of course, is moved to the front of the machine for unloading. Fig. 3 shows a close-up view of the tapping head taken from the front of the fixture.

In the operation shown in Fig. 4, twenty-three holes are tapped simultaneously in the nose section in less than one-sixteenth of the time formerly required when they were tapped one at a time. Eight of these holes, 3/8 inch in diameter with 16 threads per inch, are tapped in the hub through a flange 1 1/4 inches thick by means of the top spindle head, which is also provided with an additional spindle that carries a 1/8-inch pipe tap.

At the same time that the taps on the top head are in operation, the spindles of two horizontal heads, which are located at angles on each side of a center line passing through the casting, are utilized to tap holes in the two magneto pads. In each pad there are four holes of 3/8 inch diameter, 16 threads per inch, and three holes of 5/16 inch diameter, 18 threads per inch. A clear view of all taps and their spindles is shown in Fig. 5.

As in the preceding example, the work-fixture is loaded at the front of the table and moved back into the tapping position under air pressure. Also, an electric limit switch, as in practically all tapping operations in this plant, causes reversal of the tap rotation when the taps have been fed to the required depth.

Practically all of the holes tapped in the rear accessory crankcase in the operation shown in Fig. 6 are of the blind type. In such operations it is possible to tap to within 3/32 inch of the bottom of the hole by the methods employed. Twenty-seven taps are used at one time in this set-up in about one-thirtieth of the time required when the holes were tapped individually. These taps are 5/16 inch diameter, 18 threads per inch; 3/8 inch diameter, 16 threads per inch; and 1/8 inch pipe.

In the operation shown on the rear accessory case in Fig. 7, it is necessary to perform the

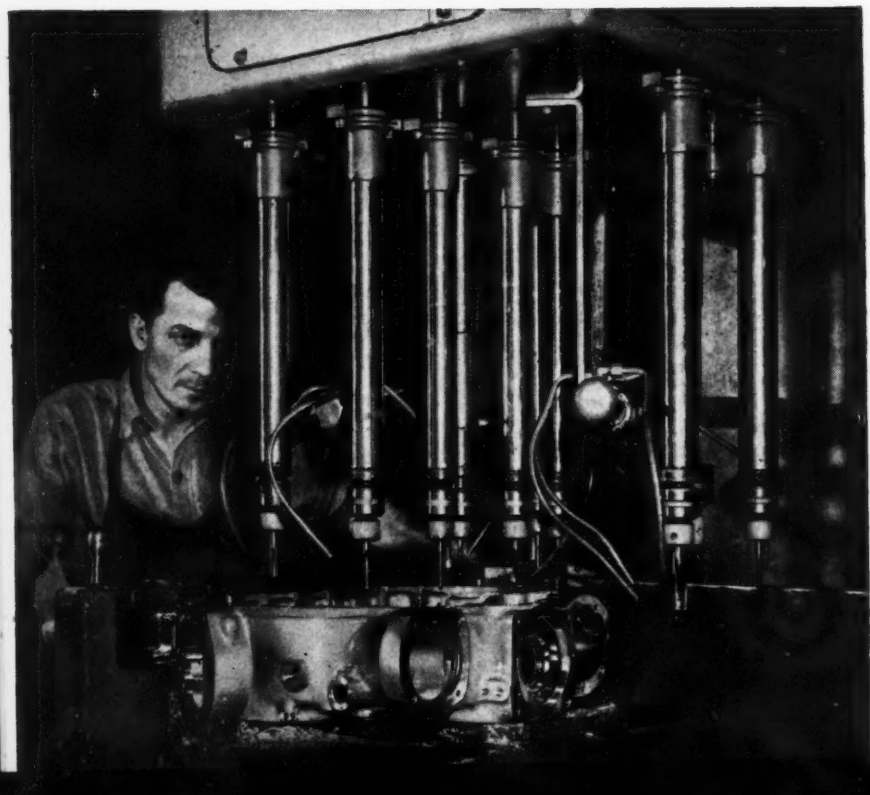


Fig. 6. (Above) The Tapping Set-up Employed for Threading a Large Number of Holes Simultaneously in a Rear Accessory Case, Practically All of the Holes being Tapped within 3/32 Inch of Blind Bottoms

Fig. 7. (Left) Another Tapping Operation on the Rear Accessory Case, where It is Necessary to Tap in Two Positions on the Same Machine because of the Close Center Distances between Some of the Holes

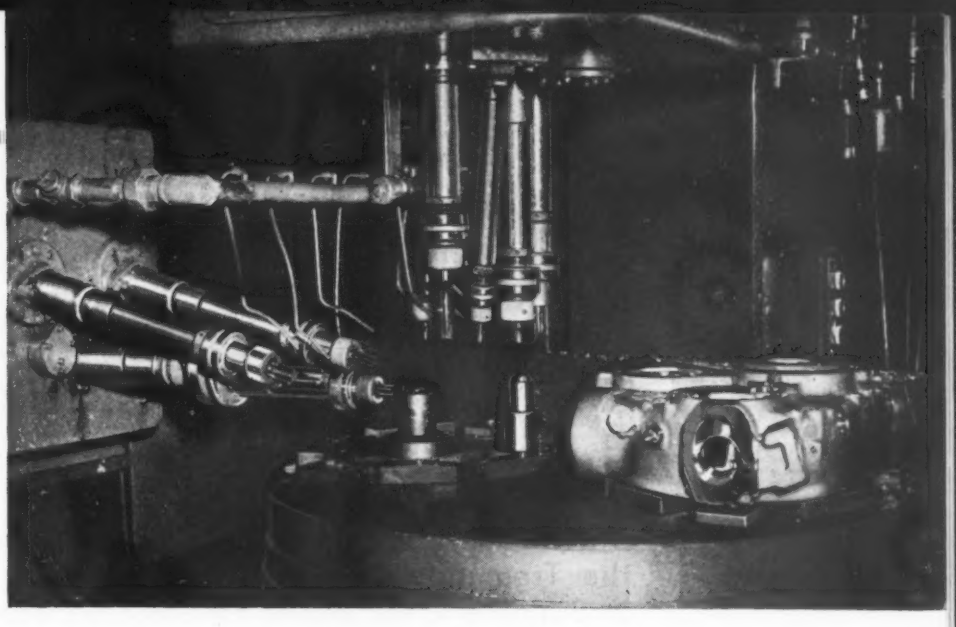


Fig. 8. Another Tapping Set-up in which Spindles on the Same Tapping Heads Operate at Different Angles to Thread Holes in Rear Accessory Case

tapping in two different positions of the work and fixture because of the close center distances between some of the holes. Eight holes are tapped in the first position at the left with the work located as shown, and four additional holes are tapped after the casting and fixture have been shifted several inches to the right. The taps range in size from 5/16 inch diameter, 18 threads per inch, up to 3/8 inch pipe. As two of the holes tapped in the first position are considerably below the others, the taps used on those two holes are fed much faster than the remainder to enable all taps to complete their work at approximately the same time.

In Fig. 8 is illustrated a tapping set-up for the rear accessory case which is unusual in that tapping spindles on the same head are fed at different angles to each other. It will be seen, for instance, that the head at the left is provided with two tapping spindles that are located in the horizontal plane and two additional spindles located at angles to that plane. Also, on the vertical head there is one spindle that is located at an angle, while the remaining four or five spindles are in true vertical positions.

It will be seen that the work-table is provided with two stations, so that one casting can be loaded while an operation is being performed on a second casting. The table is indexed in a rotary manner to carry the work into and out of the tapping position. The taps used in this operation range up to 1 3/8 inches diameter, 12 threads per inch.

Five separate spindle heads are provided on the horizontal machine shown in the heading illustration and in Fig. 9 for tapping a number of holes around the intermediate rear crankcase. The operation is performed in three stations on the machine. The work is seen in Fig. 9 in the first station at the front of the machine. Here, two spindle heads are arranged at sharp angles

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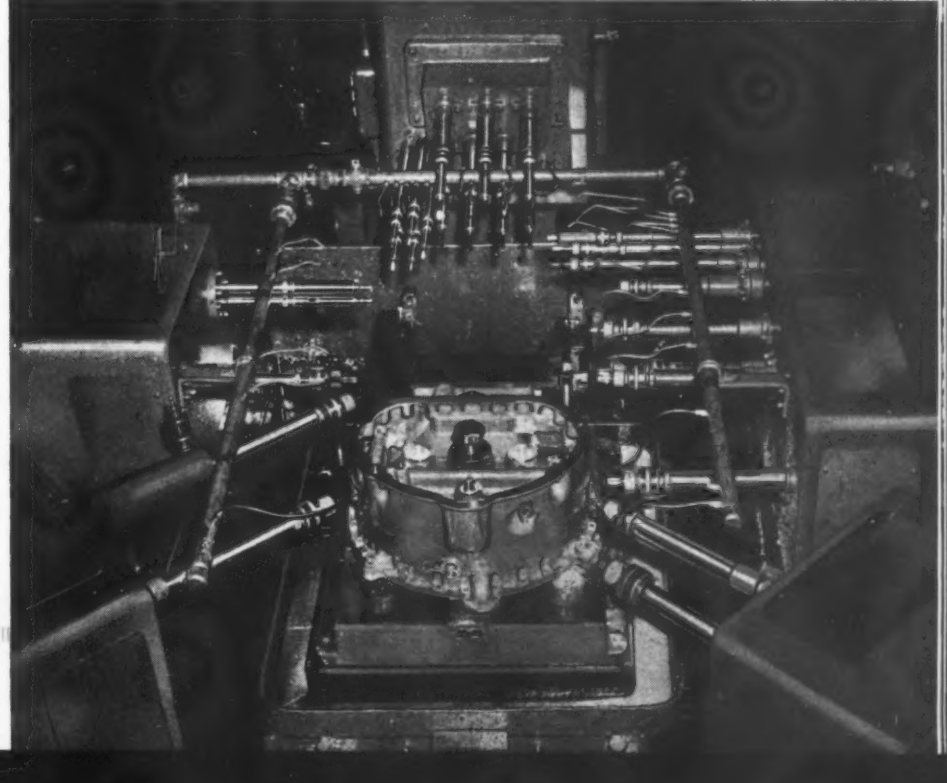


Fig. 9. Five Multiple-spindle Tapping Heads are Employed in Tapping a Number of Holes around the Periphery of Intermediate Rear Crankcase Castings, the Work being Held in Three Positions for the Operation because of Close Center Distances between Holes

Stretch-Forming Aluminum-

Unique Methods Developed by Ford Engineers to Supply the Tremendous Number of Stretched Shapes Required in Building Over 8000 Four-Engine Bombers – The Same Methods are Applicable in Aluminum Fabrication Outside of the Aircraft Industry

By CHARLES O. HERB

MILLIONS of feet of aluminum-alloy rolled and extruded shapes have been stretch-formed into structural members for the more than 8000 bombers that have been constructed in the Willow Run plant of the Ford Motor Co. The stretch-forming methods there employed differ substantially from the processes used in other aircraft plants, due principally to the fact that Ford engineers obtained their practical experience in the field of automotive mass production.

All of the stretching dies and stretch form blocks are made completely of steel, and this is true also of all dies for mechanical and hydraulic presses, which is at variance with the general practice in other aircraft factories. In fact, there are over 16,000 steel dies in the Willow Run plant, which is one of the reasons why Ford engineers have been able to maintain a bomber-an-hour production schedule in this plant. Some of the more ingenious stretch-forming methods and tools will be described in this article. These methods are not necessarily confined to the aircraft industry as they could be applied in the post-war period in many phases of aluminum fabrication.

Stretching of aluminum-alloy shapes that have been formed into contours is, of course, necessary in order to make the parts hold their formed outline. Otherwise, they would spring back from their bent or rolled forms. It would be practically impossible to produce satisfactory curved aluminum parts without resorting to a stretching process to make them retain their final form. In this respect, aluminum alloys seem to differ from practically all other metals.

A variety of stretch-forming operations are performed in this plant on mechanical presses by the use of dies equipped with serrated jaws, which grip the ends of the part and pull them lengthwise while the major portion of the part is firmly held between upper and lower die members.

A typical die set of this design is shown in Fig. 1 with a stretch-formed piece of work in place on the lower die. The same set of dies is seen in Fig. 2 with the work-piece lying in front of the lower die, so that the construction of this die member may be clearly seen. The serrated jaws of the lower die are indicated at *A*, and the mating serrated jaws of the upper die at *B*.

After these jaws have been closed securely on the ends of the work at the downward descent of the press ram, the lower jaws *A* are forced lengthwise of the die by being pushed down an inclined surface on die members *C* as the top of each jaw comes in contact with flat surfaces on the upper jaws. Members *C* are separate from the lower die, and are held stationary on the die base. The jaws *B* are moved outward in

Alloy Shapes at Willow Run

unison with the lower jaws as inclined surfaces on jaws *B* move down inclined surfaces on members *C* that are located at a point higher than the inclined surfaces with which jaws *A* come in contact.

With this arrangement, each end of the work is stretched 1/4 inch while the main portion of the piece is being accurately formed in the die. The stretched ends, which carry marks from the serrations of the jaws, are later trimmed off. Coil springs within the jaws return them against the respective die members when the ram of the press again moves upward.

The work-piece consists of an aluminum-alloy hat section measuring 3 5/8 inches across the channel, 5 5/8 inches across the flanges, and 1 3/8 inches deep in the channel. The trimmed length is 14 inches. The top of the hat section is curved to a radius of approximately 6 feet. The tolerance on the channel width after stretch-forming is plus or minus 0.010 inch. Stretch-forming with the dies described insures the required squareness of the channel throughout the length of the part and eliminates any spring-back along the contour. Pieces stretch-formed in these dies check 100 per cent against templets.

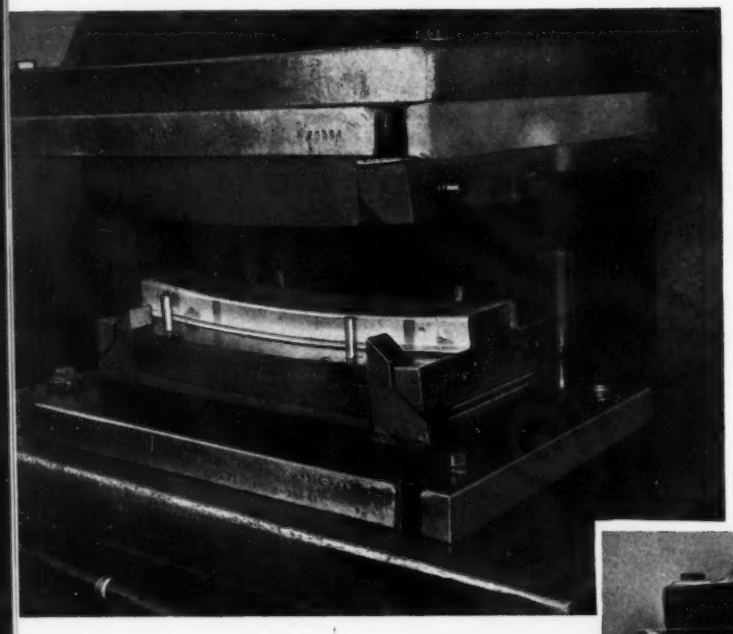


Fig. 1. (Left) Stretch-forming Operation on a Power Press Performed with a Die Set Provided with Sliding Jaws at Both Ends of the Upper and Lower Die Members that Move Lengthwise in Relation to the Part

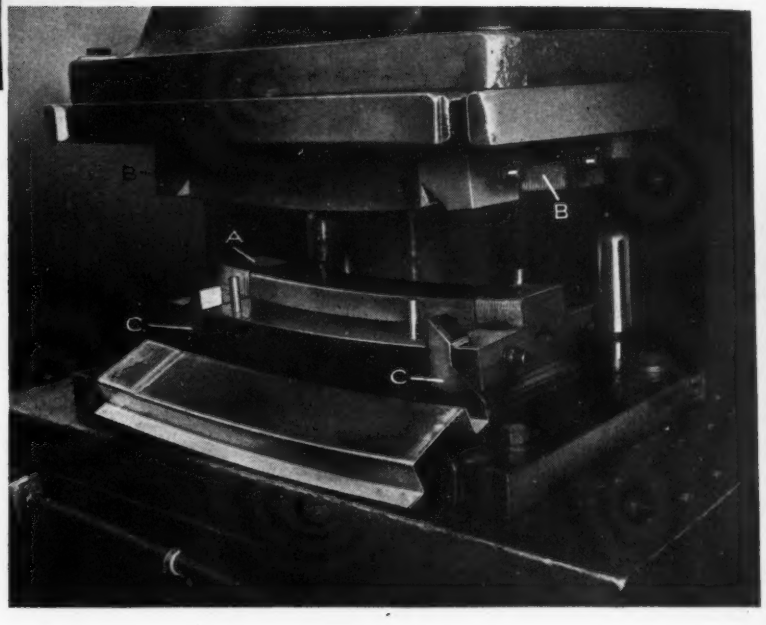


Fig. 2. (Right) Another View of the Stretch-forming Die Set Illustrated in Fig. 1, with the Work Removed so as to Show Clearly the Construction of the Jaws on Lower Die Member

Incidentally, the same set of dies is used in preforming these parts. For that operation, the central section of the bottom die is shimmed up sufficiently to keep the serrated jaws from coming into contact with each other. The formed pieces then pass through a heat-treating process and are placed in refrigerators to prevent aging until they are brought back to the stretch-forming press.

Another set of dies with stretching jaws on opposite ends is shown in Fig. 4. The operating principle of these jaws differs from that of the jaws on the dies previously described in that the lower jaws are forced outward at the same time that they are pushed down an inclined surface, while the jaws on the upper die are forced outward as they are pushed up an inclined surface. On the preceding die, both the jaws are forced outward and moved downward.

In Fig. 3 is shown a close-up view of the jaw at the left-hand end of the bottom die in Fig. 4. It will be seen that the jaw is seated on an inclined surface of a block that is mounted stationary on the die base and that the jaw is backed up by four heavy coil springs, which tend to hold it against the end of the die. The jaw is made with three serrated surfaces, two of which taper toward the outer side of the jaw, with the result that the greater the pressure on the jaw tending to push it outward, the greater will be the gripping action that is applied to the end of the work.

This die is used for stretch-forming bomb tracks of channel section which measure 1.100 inches across the outside of the channel and 0.750 inch in height. The material is 0.084 inch thick and is 24S-O aluminum alloy. The dimension across the inside of the channel must be as specified within plus or minus 0.015 inch and the varying contour of the part must be maintained within a tolerance of 1/32 inch. The close tolerances are necessary because the rollers of the bomb carriage run along the inside of the channel. The stretch-formed piece must also be flat across the bottom of the channel and the walls at a true right angle with the bottom.

In the stretch-forming operation on this part, the ends are also stretched 1/4 inch. The piece is supported in the die on a member that is backed up by a pressure pad. When the upper die descends, the work is pushed down into a depression, supported by the pressure pad. This movable die member can be seen in the center of the die in Fig. 3. Two sets of dies are used on the press at one time for simultaneously stretch-forming right- and left-hand bomb-carriage tracks.

These bomb-carriage tracks are also preformed with the same dies. In this instance, the serrated jaws are shimmed up for the stretch-forming operation. These shims are removed prior to preforming, with the result that in the preforming operation the jaws do not come in contact with each other. Sheets of aluminum alloy blanked to the required radii and width are laid between locating blocks on the lower die for the preforming step. Four of these locating blocks may be seen in the illustration. After the preforming operation, the work-pieces pass through the heat-treating process and are held under refrigeration until they are sent to the stretch-forming press.

Fig. 3. (Left) Close-up View of the Serrated Stretching Jaw at the Left-hand End of One of the Stretch-forming Dies Seen in Fig. 4

Fig. 4. (Right) Another Set of Stretch-forming Dies Equipped with Moving Jaws that Stretch the Work-piece while the Shape is Closely Controlled by the Upper and Lower Die Members

Fig. 5. (Left) Stretch-forming Die Employed on a Heavy Mechanical Press for Stretching Channel Sections Approximately 6 Feet in Length. This Die is Equipped with Moving Jaws of the Same Design as Those on the Dies in Fig. 4

Fig. 6. (Right) Another Stretch-forming Die in which Stretching is Effected by the Use of Stationary Jaws which Produce Shoulders 5/16 Inch High on the Work

Before this set of dies was devised, these bomb-carriage tracks had to be made of 61S-O stock. After being formed, heat-treated, and stretch-formed, a considerable amount of hand work was necessary in order to make the pieces fit templets. With the new process, the pieces can be formed from a less expensive material and all hand work has been eliminated.

The bottom member of another die set of the same general design is illustrated in Fig. 5. This die was produced for stretch-forming belt frames about 6 feet in length, which are made of a channel section 2 1/2 inches in width by 0.750 inch in height. The tolerance on the cross-section dimensions is plus or minus 0.030 inch, while the tolerance on the contour dimension is plus or minus 1/32 inch. The jaws are designed to stretch each end of the part 5/8 inch. The work-pieces are also preformed in this die from blanks cut to suitable outline.

Stretch-forming without the aid of sliding jaws is accomplished with the die set illustrated in Fig. 6. In this case, the lower die is fitted with stationary blocks or jaws at each end, which are positioned somewhat higher than the adjacent surfaces of the die for the stretch-forming operation. When the work-pieces are formed in this die, the tops of these jaws are flush with the adjacent portions of the die. They are shimmed up 5/16 inch, as shown, for stretch-forming. This provides 5/16 inch of stretch at each end of the contour. The shoulders left on the work-piece, as seen on the bottom one of the two work examples illustrated, are later trimmed off. This part is made to two large radii, one approximately 4 feet and the other

about 7 feet. The 24S-O material from which the part is made is 0.032 inch thick.

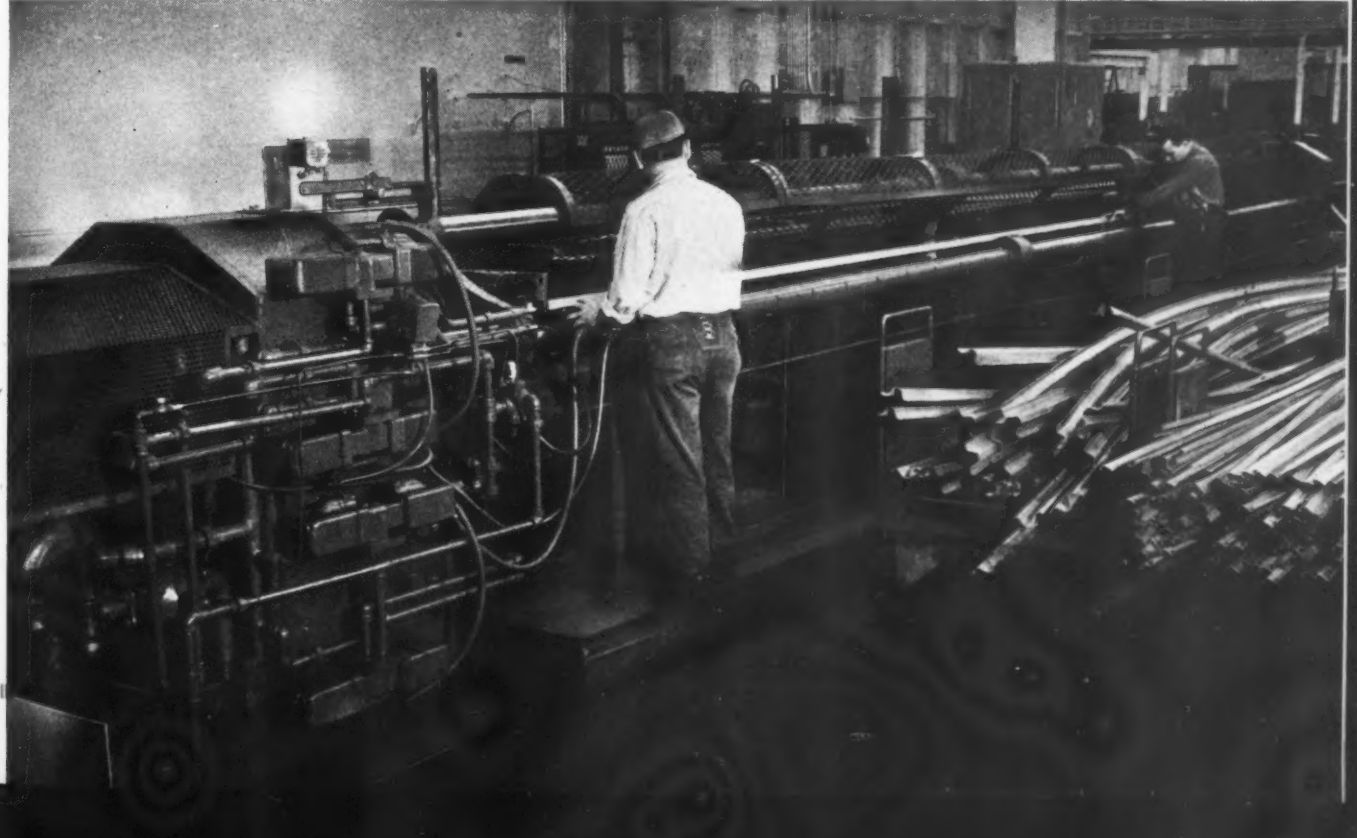
Stretch-forming machines designed for operations on extruded shapes are employed in a wide variety of types, built to meet individual problems. In Fig. 7, for example, is shown a machine of 75 tons pulling capacity, which is used exclusively for stretch-straightening long hat sections that have been twisted during heat-treatment. The operation also increases the tensile strength. Pieces up to 25 feet in length can be accommodated. Hat sections of that length may be warped as much as 2 feet when they are delivered to the machine.

The machine is constructed with a hydraulically operated pulling head at the left-hand end and a stationary head at the right. The latter head is, however, adjustable along three heavy bars that extend the length of the machine for handling various lengths of work. In loading a part, the left-hand head is advanced a predetermined distance toward the right and the part is loaded into the hydraulically actuated jaws of both heads. Then, the left-hand head is moved toward the left under hydraulic power to stretch the part from 3 to 4 per cent and give it a permanent set. The movement of the pulling head is stopped when a Micro Switch is actuated to reverse the action of the hydraulic cylinder that operates the head.

A close-up view of the pulling head is seen in Fig. 8. The jaws are mounted on surfaces of the chuck that are inclined 10 degrees from front to back in such a way that when the jaws are pulled back along the tapered surfaces at the end of an operation they are automatically opened to release the part. The jaws are pushed forward on these tapered surfaces under hydraulic power after a part has been loaded to close them securely on the part. Identical jaws are provided on the pulling and stationary heads.

The jaws are serrated and are tapered away from the front end, so that the greater the pulling action exerted, the greater the gripping power of the jaw. Stock to a length of about 3 inches is gripped in each jaw. The hat sections being operated upon in the illustrations are 4.5 inches in maximum width by 1.5 inches in maximum height. The thickness of the material is 0.120 inch. When these hat sections are removed from the machine, they are straight throughout their entire length within an unusually close tolerance. The wire-mesh guard seen extending along the top of the machine in Fig. 7 was provided to guard against injury to the operators in the event that a work-piece

Fig. 7. Hydraulically Actuated Machine with a Pulling Power of 75 Tons which is Used for Stretch-straightening Sections of Various Types Ranging in Length up to 25 Feet



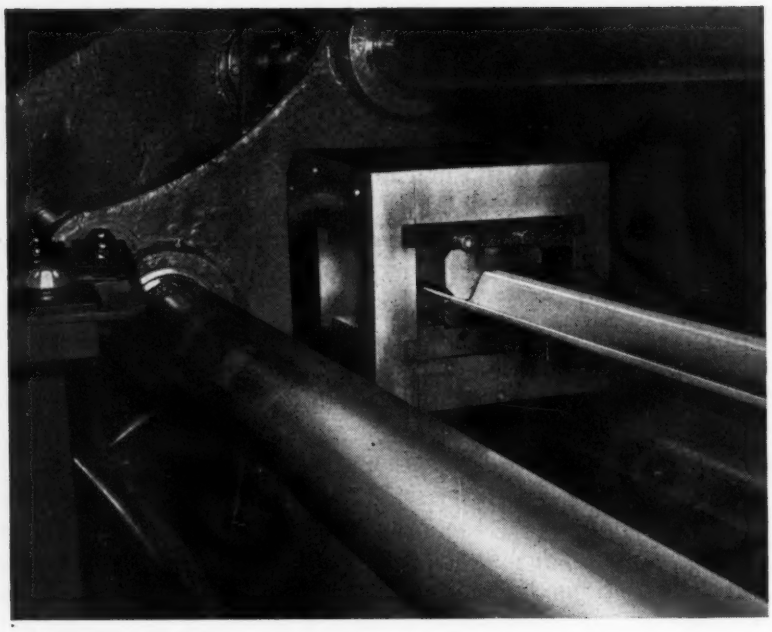


Fig. 8. (Left) Close-up View of the Pulling Head on the Machine in Fig. 7, Showing Chuck Provided with Jaws Suitable for Gripping a Hat Section

Fig. 9. (Below) Set-up Employed for Stretch-forming a Z-section with the Part Held Firmly between a Lower Form and an Upper Rubber-faced Form that is Pushed Down on the Work under 16 Tons Pressure

should be defective and should fail during the performance of the operation.

For certain stretch-forming operations, use is made of set-ups in which pressure is exerted from an overhead hydraulic unit to hold the part to its correct cross-section while horizontal hydraulic heads are pulling the shape lengthwise. A typical arrangement of this kind is shown in Fig. 9. The preformed Z-section stringer is placed between upper and lower form blocks. The upper block is attached to two rams actuated by hydraulic cylinders which are mounted on top of a structure fabricated from steel beams. Rubber is provided on the face of the

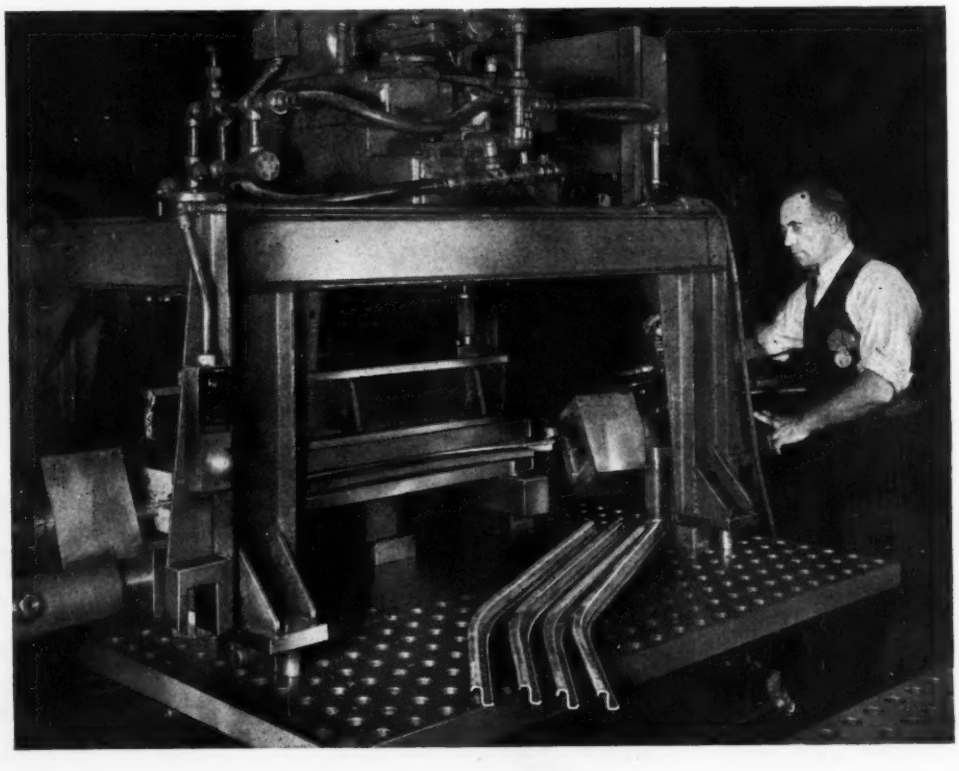


Fig. 10. Stretch-forming Operation in which the Work-piece is Held Firmly against a Stationary Block by a Form Block that is Mounted on a Slide Actuated Horizontally by Hydraulic Power

top form to insure that pressure will be exerted uniformly along the work-piece.

A pressure of 8 tons is applied by each of the two cylinders to hold the part firmly between the upper and lower form blocks. The ends of the piece are then gripped in serrated jaws on two separate self-contained hydraulic units that are positioned on opposite sides of the table in the required relation with respect to the form blocks. When these units are actuated, the ends of the shape are stretched about 3 1/2 per cent to insure a permanent set within the prescribed limits.

A somewhat similar set-up is used on a section rolled from thin strip stock, as shown in the heading illustration. This part has a wavy contour along the horizontal flange that must be closely maintained. The part is placed between a bottom female form block and an upper rubber-faced male form block. The ends of the piece projecting from the form blocks at the right-hand end are then gripped in the jaws of two hydraulic units, which are installed side by side at the right-hand end of the table. With this equipment, a comparatively light section can be stretch-formed to meet specified requirements.

There are instances when it is desirable to exert pressure horizontally against a form block instead of on top. Such an example is presented in Fig. 10. A form block is mounted in a stationary position on top of a table which is equipped with a hydraulic cylinder underneath. Through a lever arm pivoted close to the floor and connected near the middle to the piston-rod of the hydraulic cylinder, movement can be imparted to a slide on the table. Attached to this slide is a form block that is the converse of the stationary form block.

After a piece of rolled work has been seated on the stationary form block, the piston in the hydraulic cylinder beneath the table is actuated to push the sliding form against the work and grip it firmly between the two forms. Individual hydraulic heads mounted on the table at the rear of the form blocks are then actuated to stretch-form the work. Each of the hydraulic cylinders is of 15 tons rating. Both form blocks can be adjusted vertically on the table.

Machining Operations in

Typical Operations in One of the Progressive Machine Shops of the Aircraft Industry that have Resulted in Large Production Economies

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Building Superfortresses to Bomb Japan

By EARL DELANEY, Assistant Superintendent
Boeing Aircraft Co., Seattle, Wash.

IN April of this year, the last B-17 Flying Fortress of a total of 6839 built at the Seattle plant of the Boeing Aircraft Co., winged its way from the assembly floor. Since then, the plant has been devoted exclusively to turning out the B-29 Superfortresses, which are being increasingly used in bombing homeland cities and outposts of Japan. Production methods developed during the years of "Fortress" manufacture, as well as newly devised practices, are now being applied in producing these larger and more powerful planes. Some of the unusual operations in the machine shop not heretofore described in MACHINERY will be dealt with in this article.

One striking job consists of threading long wing-flap retracting screws to extremely close tolerances by employing a standard die-head on a turret lathe. This operation is illustrated in Fig. 1, while Fig. 2 shows a close-up view of the 3-inch Landmatic die-head used. In the particular operation shown, an Acme single thread of 2 inches diameter, 4 threads per inch, was cut to a length of 45 1/2 inches on a heat-treated alloy-steel tube 48 inches in length. The thread lead in these operations must be held to within plus or minus 0.0005 inch, and the thickness of thread or pitch must be maintained within plus nothing, minus 0.002 inch.

The material is a heat-treated tube of SAE 4130 steel with a tensile strength of between 125,000 and 145,000 pounds per square inch. The tube is 2 inches outside diameter and 1 1/2 inches inside diameter, leaving a wall thickness of 1/4 inch. Because of the tubular cross-section, considerably more difficulty would ordinarily be experienced in cutting the thread than if the operation were performed on a solid bar.

Only one cut is taken in forming the thread from the blank tube, and the actual cutting time on a screw of the length mentioned is only twenty-three minutes. This represents a tremendous saving in time over the former practice of chasing and grinding the thread, grinding being no longer necessary because of the accurate performance of the die-head chasers. The work is run at 8 R.P.M.

One of the secrets of success in this operation is the method of grinding the die-head chasers. They are hollow-ground both ways in the Boeing tool-room—that is, back from the cutting edges and also crosswise of the chasers. The back rake is 10 degrees. Each chaser is provided by the manufacturer with a projecting lug along the front edge, as may be seen in Fig. 3. The lugs on the four chasers used at a time on the die-head provide a full supporting self-centering guide for the work ahead of the chaser cutting edges, and thus insure concentricity of the tube with the chasers. How these self-centering lugs operate will be apparent from Fig. 4, which shows the die-head about to start threading a tube.

Another secret of success in this threading operation is the provision of a power wrench for the headstock chuck. When the operation was performed on another lathe equipped with a hand-operated chuck, difficulty was experienced in gripping the work sufficiently to withstand the cutting pressure. The die-head is adjustably mounted on the turret face, so that it can be accurately aligned with the center line of the chuck. A dial indicator is employed to check the setting. Cutting fluid is supplied copiously.

Considerable use is made of multiple carbide cutters in various machining operations. Fig. 5 shows a typical set-up of this kind on a turret

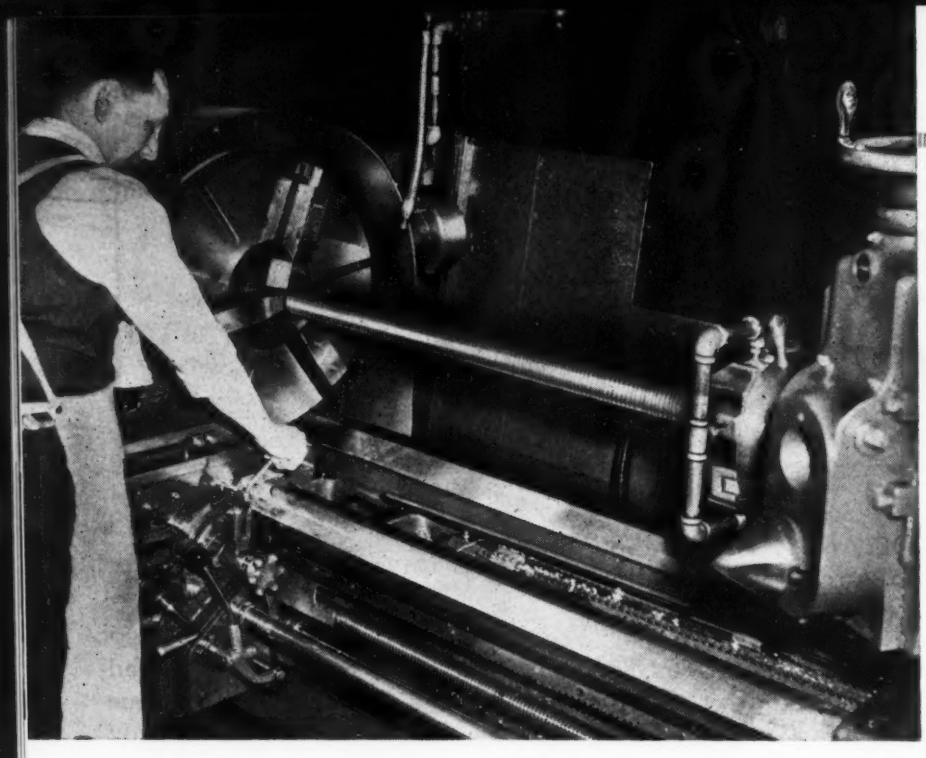


Fig. 1. Cutting an Acme Thread 2 Inches in Diameter, 4 Threads per Inch, for a Length of 45 1/2 Inches to Unusually Close Tolerances by Using a Standard Die-head on a Turret Lathe

lathe for machining bores and faces of various diameters and lengths on a magnesium casting. There are five separate carbide cutters mounted on an arbor that fits into a special adapter which is held on a slide on one of the turret faces. The cutters are clamped between an outer flange of the arbor and the nose of the adapter.

Four bores ranging from 2.20 to 2.4407 inches in nominal size are machined simultaneously with this built-up tool, and in addition, a blind hole of 5/8 inch diameter is bored in the inside of the casting. On the larger holes, the tolerance runs as close as plus nothing, minus 0.0005 inch. All bores are machined to size in one cut, with the exception of a bore for a bearing, about 1/8 inch of stock on the diameter being removed. The bearing bore is roughed in the same operation and finished with another carbide tool on the same machine. Besides the boring cuts, a chamfering cut is taken around the outer hole.

The cutter for the small blind hole is made with a single carbide cutting edge, while all the boring cutters for the larger holes have two carbide tips, and the chamfering cutter has four tips. The blind-hole cutter is mounted on a shank having a thread to permit screwing it into one end of the arbor. The turret lathe is equipped with a special fixture that can be indexed to enable three sides of the work to be similarly machined. Tapping of one of the bores is performed in the same work set-up by a collapsible tap mounted on another face of the turret.

Negative-rake milling cutters are used extensively in this plant, as described in an article

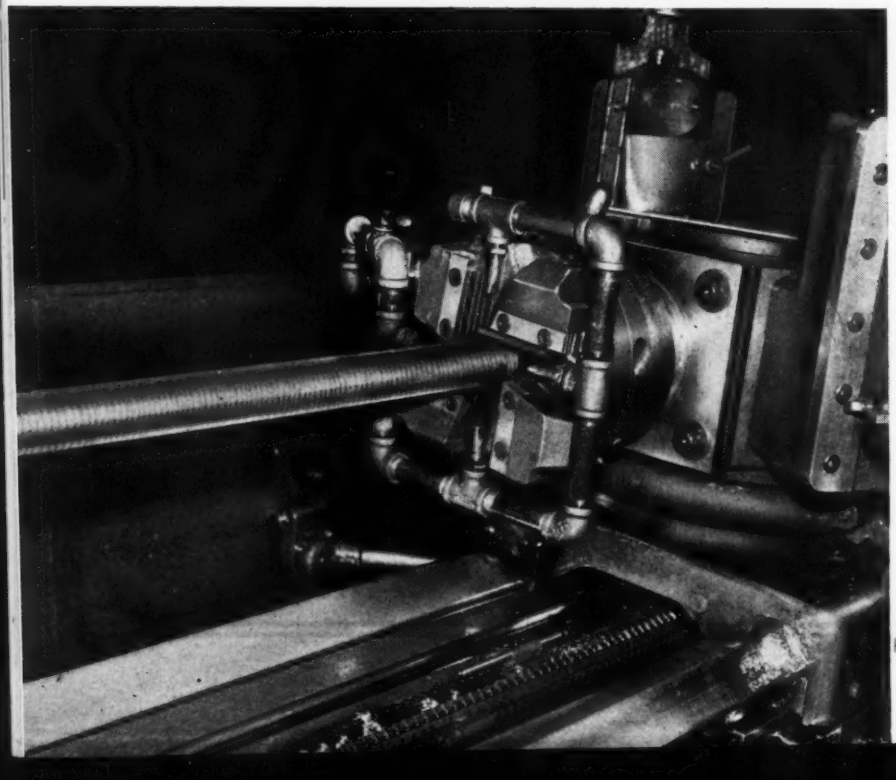


Fig. 2. Close-up View of the Die-head Used in the Retracting-screw Threading Operation after the Die-head has been Opened up and Returned Almost to Its Starting Position

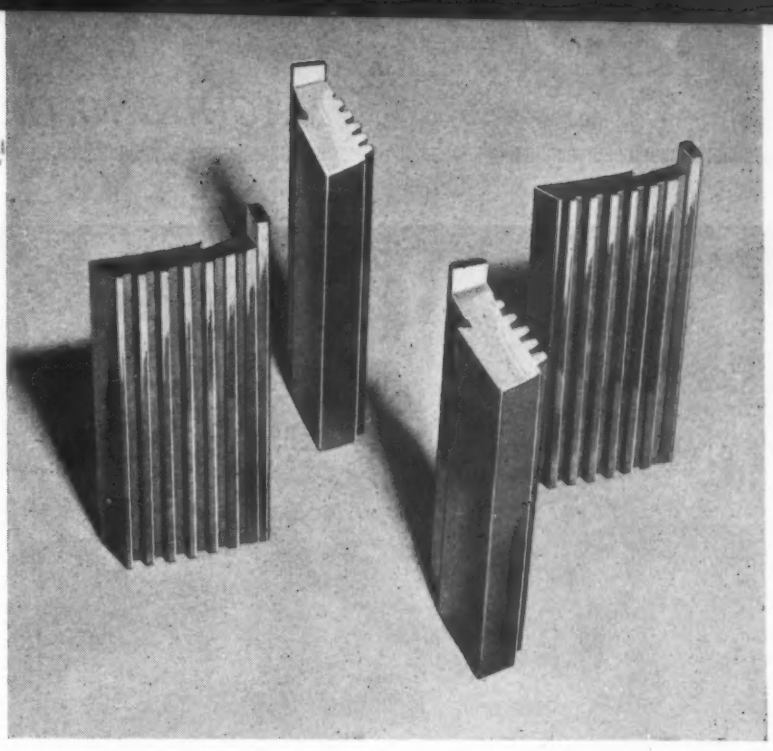


Fig. 3. View of Four Chasers Employed in the Threading Operation on the Retracting Screw, Showing the Work-centering Lugs and Method of Hollow-grinding the Chasers

published in March, 1944, MACHINERY. Fig. 6 shows a recent set-up in which the staggered carbide-tipped teeth are set at a negative radial rake angle of 10 degrees, but at a positive helix angle of 10 degrees. A positive helix angle is used in this instance to keep the cutting pressure from being higher than the fixture can withstand. A positive helix angle also permits better chip control in cutting slots of great depth. This cutter machines a slot 0.800 inch wide to a depth of 2 inches on one side of the SAE 4340 steel forging, and to a depth of 3 inches on the other side.

The 10-inch diameter ten-tooth cutter is run at 151 R.P.M. This is a comparatively slow speed for this type of cutter, but the speed is restricted because the only means available for supporting the work on the right-hand side of the fixture was somewhat inadequate. When the work-table is fed from right to left, a table feed of only 3 inches a minute is used, but when the table is fed from left to right a feed of 6 1/2 inches per minute is employed, because the work is well supported on the left-hand side.

Rough- and finish-boring cuts are taken successively on a landing-gear forging, using a horizontal boring mill and the tooling set-up shown in Fig. 7. The cuts are taken by tungsten-carbide inserts positioned in line with each other, as shown. A facing cut is also taken on the end of the forging.

The roughing cutter removes from 3/16 to 1/4 inch of stock on the diameter, and the finishing cutter, 0.020 inch of stock on the diam-

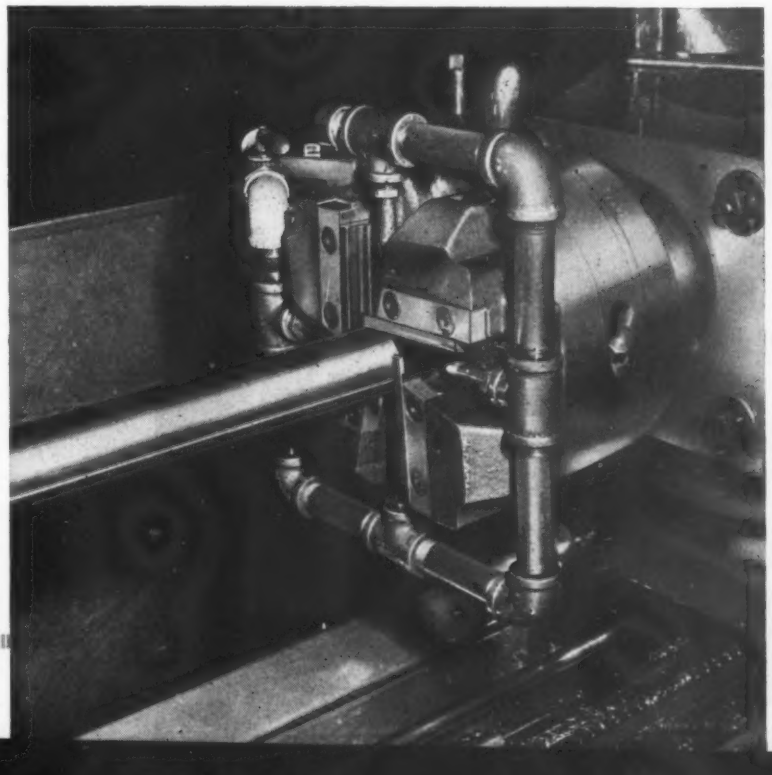


Fig. 4. Illustration that Shows How the Lugs on the Die-head Chasers Function during the Threading Operation on Retracting Screws to Center the Tube in Relation to the Chasers

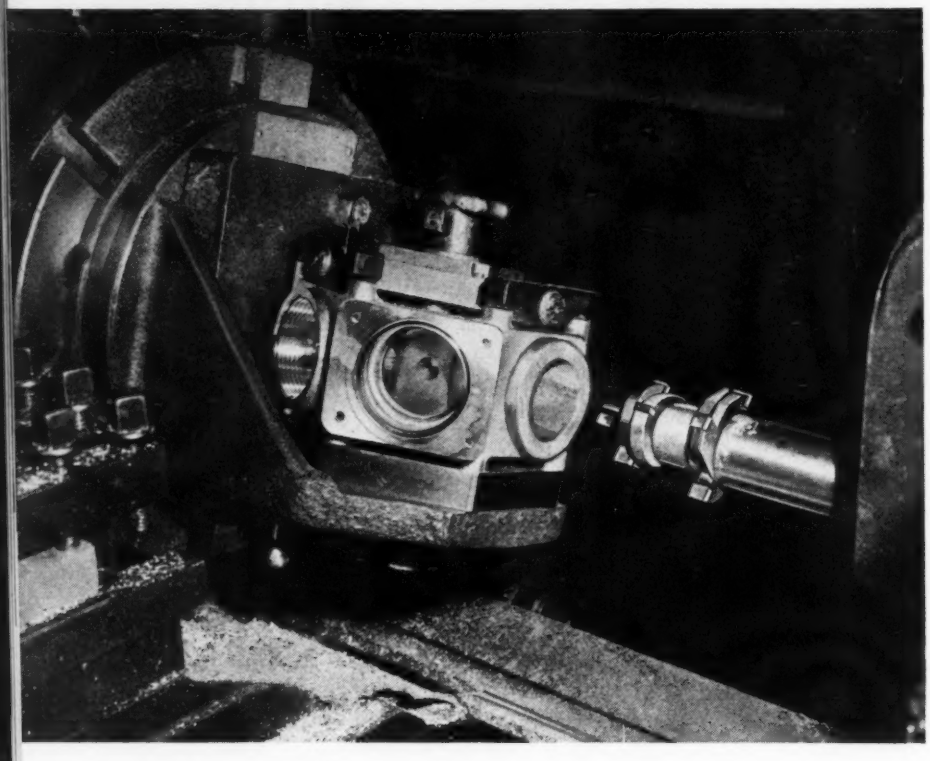
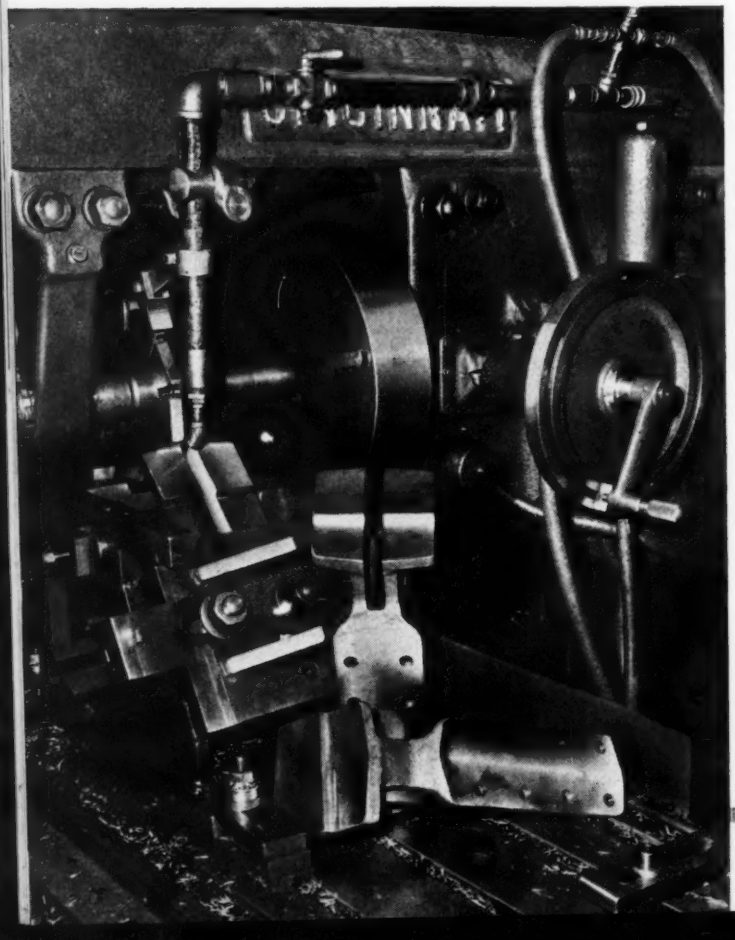


Fig. 5. Individual Carbide-tipped Cutters are Mounted in Multiple on an Arbor for Performing Simultaneous Boring and Chamfering Operations on Turret Lathes, as well as Other Types of Machine Tools

Fig. 6. A Slotting Operation on an Alloy-steel Part of High Tensile Strength, in which a Staggered-tooth Cutter is Employed with Teeth Set at a Negative Radial Rake Angle and a Positive Helix Angle



eter. At the time that the roughing cutter is in use, the boring-bar speed is 142 R.P.M. It is speeded up to 204 R.P.M. for the finishing cut. The feed in roughing is 0.005 inch, while in finishing a finer feed of 0.003 inch is employed to eliminate tool marks. The roughing cutter is ground without rake, while the finishing cutter has a positive rake of 1 degree.

The bore is 3 inches in length, and is finished to 4.500 inches diameter within plus 0.002 inch, minus nothing. The forging is heat-treated prior to this boring operation, and has a tensile strength of 190,000 pounds per square inch.

Large production economies have been effected by the "strip" drilling of extruded shapes that are later cut up into short pieces. With this practice, extruded shapes up to about 8 feet long are drilled along their entire length in successive stages, the shapes being advanced through jigs after each feed and return movement of a multiple-spindle drill head. In the typical operation illustrated in Fig. 8, a dozen or more small holes are drilled at one time. After the first holes have been drilled, the work is accurately located for the succeeding steps by pushing it through the jig and inserting a locating plug into one of the drilled holes.

Later on, this extruded shape is cut into short

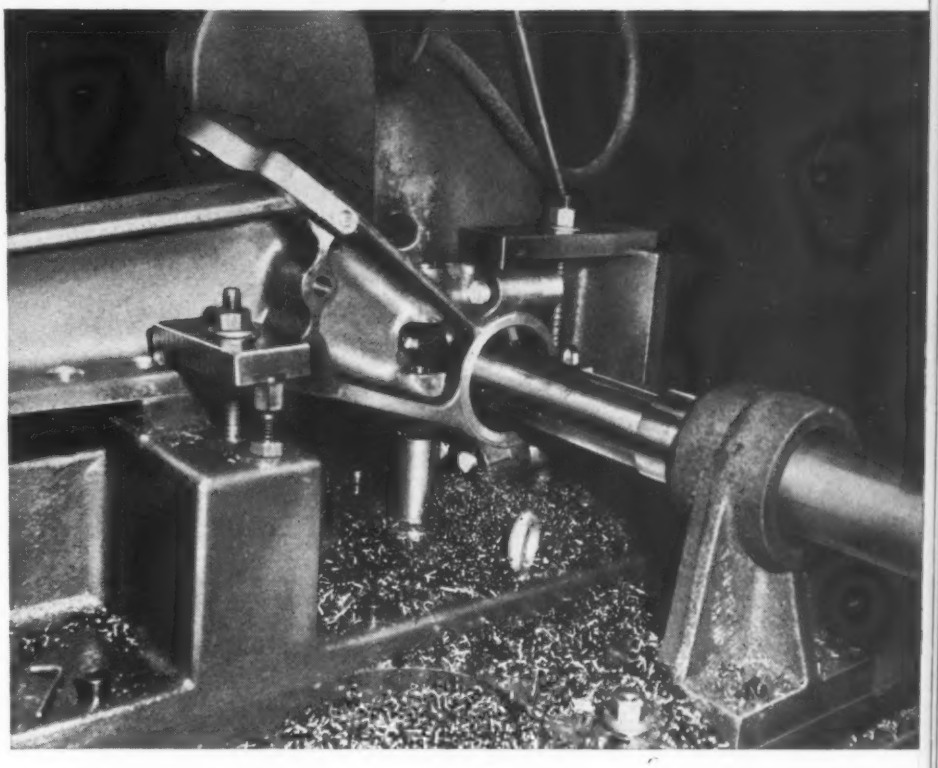


Fig. 7. Carbide-tipped Cutters are Used in Succession for Rough- and Finish-boring and Facing a Heat-treated Alloy-steel Landing-gear Forging that must be Machined to an Unusually Close Tolerance

lengths with three holes in each piece. When the holes were drilled after the short pieces were cut, only three could be drilled at a time.

A 22-inch diameter saw fitted with 130 tungsten-carbide teeth is employed on the Cochrane-Bly machine illustrated in Fig. 9 to saw the extruded shapes to required lengths after "strip" drilling. This sawing operation is completely automatic. First the work feeds from right to left against a stop, then the saw advances through the work and returns to its starting position, after which the work again feeds to the stop, and so on. This cycle is repeated without interruption until the entire shape has been fed completely past the saw. The slide that carries the saw is fed back and forth by hydraulic power, and the vise jaws are also operated hydraulically. The slide that carries the work is actuated pneumatically.

On 24S-T aluminum alloy, a regular high-speed steel saw lasted approximately two hours between resharpenings on this type of work, whereas the tungsten-carbide tipped saw can be operated constantly for twenty hours before resharpening is necessary. The saw runs at 1400 R.P.M., or approximately 8000 feet a minute.

A face milling cutter with two carbide tips brazed solidly to the cutter-head, as shown in

Fig. 8. Long Extruded Shapes are Drilled with Multiple Drill Set-ups to Save Production Time, and are Later Cut into Short Pieces, instead of Drilling the Pieces Individually, as in Former Practice

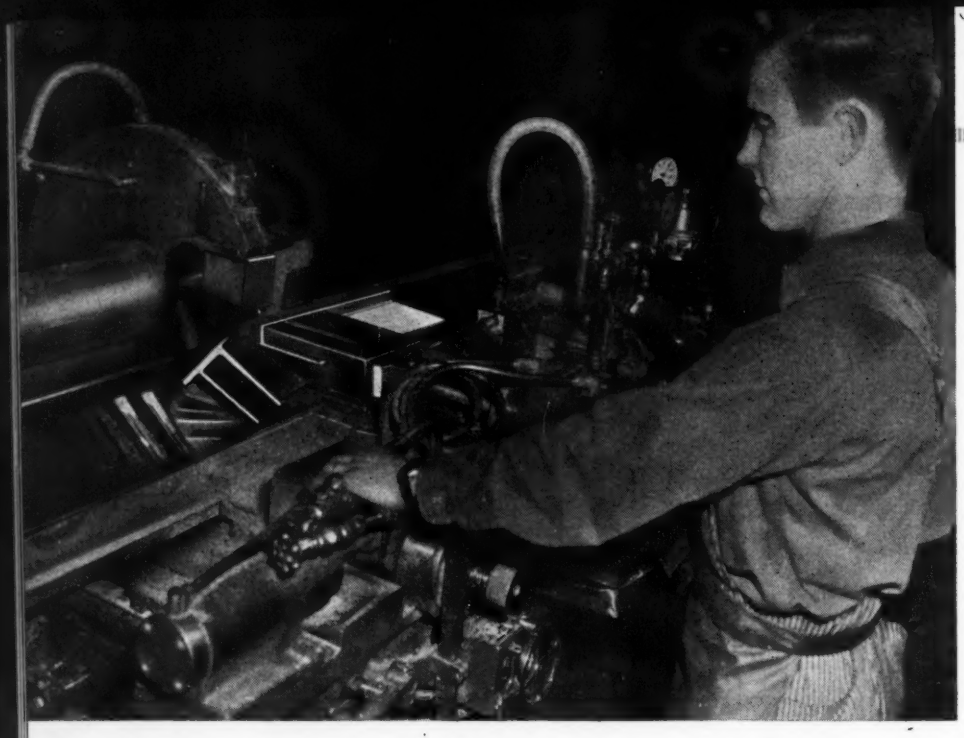


Fig. 9. Cutting a "Strip" Drilled Extruded Shape into Short Lengths on an Automatically Operated Machine Equipped with a Circular Saw that Has 130 Carbide-tipped Teeth

Fig. 10, is used for the high-speed milling of aluminum-alloy wing spars. This cutter, which is 3 3/4 inches in diameter, is run at a speed of 10,800 R.P.M. by a Sawyer high-cycle synchronous motor, which gives a cutting speed of over 9300 feet per minute. The carbide tips are 1/2 inch wide. They are set to a neutral radial rake and to a positive helix angle of 5 degrees.

The contour of the spar is milled under the control of a templet which extends along the front of the bed. Six cuts are taken in removing stock to a maximum depth of 0.180 inch, the greatest depth of any cut being 0.090 inch. The table feed is 18 feet per minute. The cutterhead is made separate from the shank, so that if the head should become damaged it would not be necessary to make up a complete new tool. The shank is screwed into the head and keyed.

Fig. 10. Face-milling Operation on a Wing Spar in which a Cutter 3 3/4 Inches in Diameter is Run at a Speed of Over 10,000 R.P.M. by a High-cycle Synchronous Motor. The Feed is 18 Feet per Minute

Fig. 11. Special Machine Devised for Routing Shapes Rolled and Stretched into a Curve to a Sawtoothed Outline by Employing a Routing Head Mounted on a Hinged Arm Attached to a Carriage

Stretched shapes are routed to a sawtooth outline on the special machine illustrated in Fig. 11, which was designed by Boeing engineers. This machine is provided with a carriage that is equipped with a motor-driven routing head, mounted on a hinged arm. There is a roller on the hinged arm that runs on a templet which is curved to the contour of the work-piece. Thus, the routing head is always supported at the proper height in relation to the changing contour of the work. The weight of the arm and routing head is compensated for by an air piston and cylinder.

The routing head is attached to a ram of square cross-section which can be pulled in and out of the hinged arm by hand to rout the work to the sawtoothed outline as the carriage is rolled along its double track which extends the full length of the machine. This contour is controlled by a second templet, clamped on the work as shown. A roller on the router spindle, slightly larger in diameter than the cutter, runs against the edge of this templet.

A battery of Sundstrand horizontal milling machines was installed for performing a variety of operations on the ends of the wing spars. The heading illustration shows one of these machines

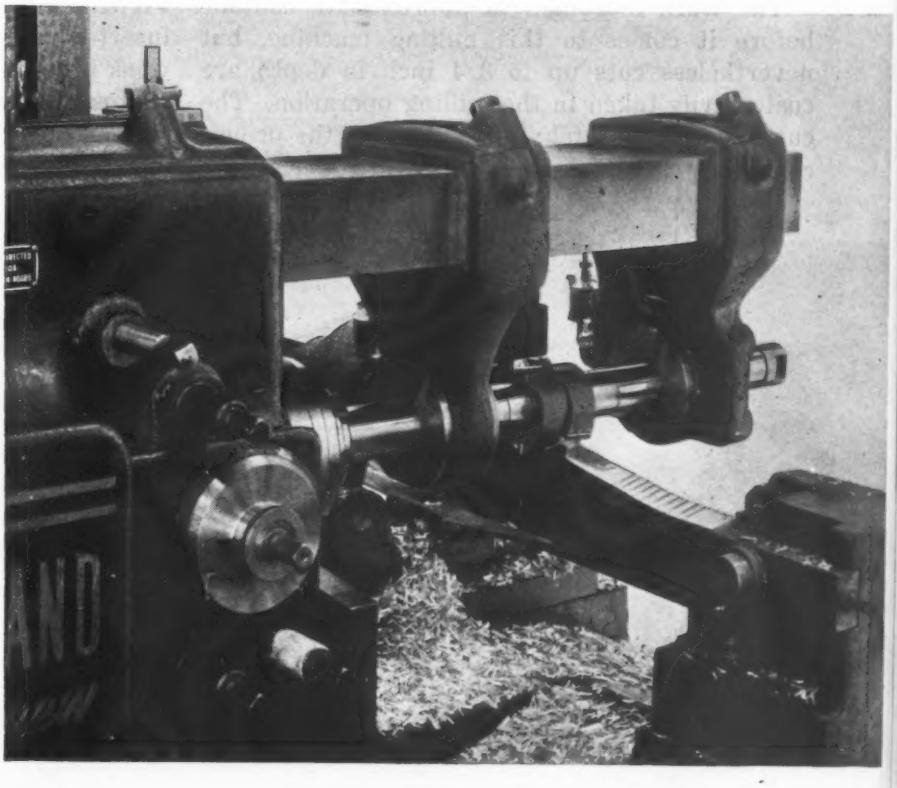


Fig. 12. Two Interlocked Slab Milling Cutters with Tungsten-carbide Blades Taking a Heavy Cut on One End of a Wing Spar that has previously been Roughed to Approximate Contour on a Routing Machine

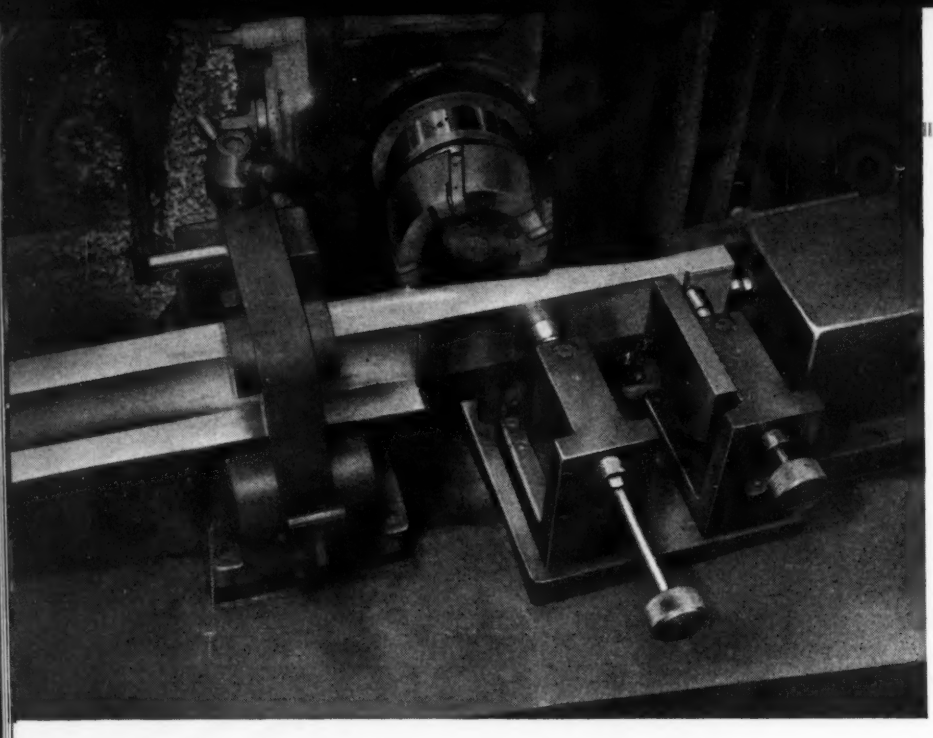


Fig. 13. Another High-speed Milling Operation on the End of a Wing Spar, which Involves the Use of a Four-blade Face Milling Cutter. In This Case, the Tungsten-carbide Teeth are Brazed to Inserts

equipped with three cutters, each of which has two carbide blades. The cutters are 8 inches in diameter and are run at a surface speed of approximately 5000 feet a minute. Surfaces from 4 1/2 to 6 inches in width are milled at speeds varying from 10 to 16 inches a minute, the different rates of feed being conveniently obtained through the "Fluid Screw" feed mechanism. The cutter teeth are positioned at a positive radial rake angle of 6 to 10 degrees and at a positive helix angle of 10 degrees.

The work is routed to approximate contour before it comes to this milling machine, but nevertheless cuts up to 3/4 inch in depth are customarily taken in the milling operation. The cutters are accurately guided to give the proper contour to the work by means of a roller on the cutter-head which rides on a cam at the back of the table, as shown. Tolerances at least as close as plus 0.010 inch, minus 0.005 inch must be maintained on all spar-milling work.

Slab milling cutters of 4 inches diameter with two carbide-tipped teeth brazed directly to the body are seen in Fig. 12 taking a cut approximately 3/8 inch deep. A feed of about 0.005 inch per cutter tooth is used.

Face-milling at a speed of approximately a mile a minute is performed with the set-up seen in Fig. 13, which shows a cutter provided with four inserted carbide-tipped blades. In this case, the work is set up at an angle to obtain the required contour on the side of the spar. A somewhat similar operation with a cutter of larger diameter is illustrated in Fig. 14.

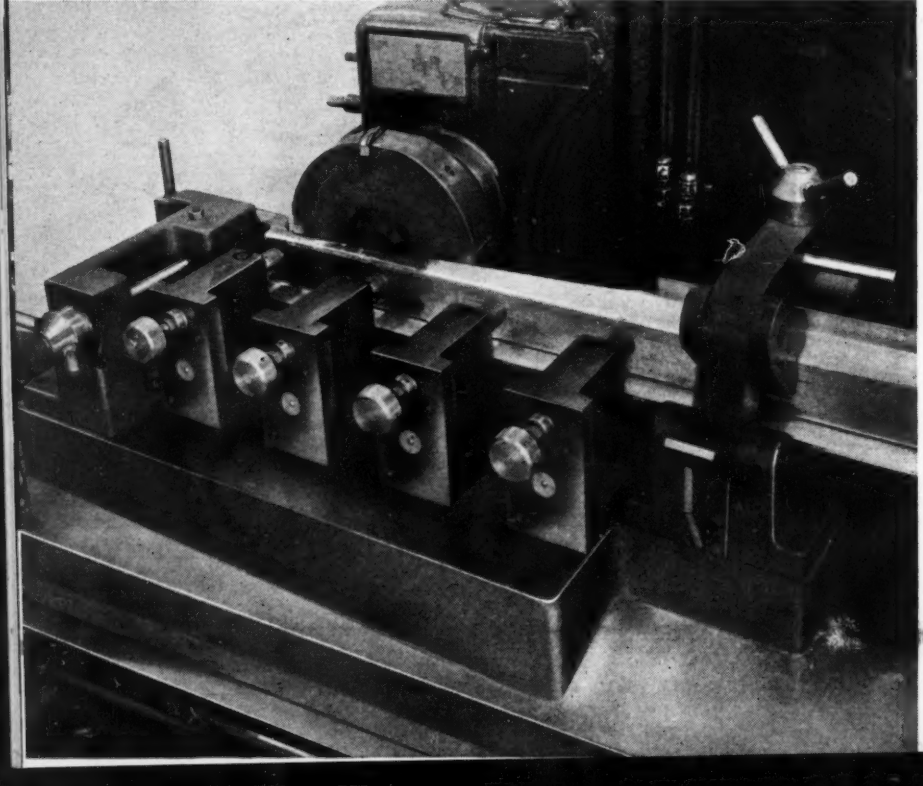


Fig. 14. Face-milling Operation on Wing Spar in which the Cutter is of Somewhat Larger Diameter than the One Seen in Fig. 13, the Work being again Positioned at an Angle to Obtain Required Contour along the Side of the Spar

Silver-Brazing Production Methods at North American

(Continued from page 169)

Two small brass gears are being brazed together in Fig. 16 by using a small washer stamped from 0.003-inch thick "Sil-Fos," a brazing material consisting of 80 per cent copper, 15 per cent silver, and 5 per cent phosphorus. This material is free flowing at 1300 degrees F. The washers are 5/16 inch in diameter, and have a 3/16-inch hole in the center. Incidentally, brass parts require heavier fluxing than steel parts, because the brass must be covered with flux in order to prevent scaling.

In this operation, the heating cycle of twenty-three seconds is followed by a delay of four seconds, after which there is a direct water quench for a period of three seconds. The water washes the flux from the part and quickly cools it. These gears are then placed in the caustic soda bath for from one to two hours, after which they are given a second bright dip. This is followed by a wash in water, and then each part is individually dried by blowing air on it. Production averages 120 brazed gears per hour.

For this brazing operation, a block of carbon was provided to support the work, after experimenting with various types of supports. First, a Transite support was found not to be sufficiently durable, and then a chromium-molybdenum steel support cracked from the intermittent heating and quenching after only fifteen gears had been brazed. A cold-rolled steel support warped badly in brazing only twenty-five parts, while a copper support was unsuitable because the silver brazing alloy adhered to the copper. This adherence occurred also on all the other supports. The carbon block is not affected by heat, and brazing alloy does not stick to it.

It was previously mentioned that closeness of fit is not so important in silver brazing as in copper brazing. A clearance of from 0.003 to 0.010 inch is satisfactory on the diameter of round slip joints. In fact, closer fits are undesirable, because when the fit is too close, the silver alloy will not flow freely enough and full joint penetration will not be attained.

Heating in brazing operations should be slow enough to allow both parts of a joint to reach nearly the same temperature and be within the fluid range of the flux and the silver alloy. If one part is heated faster than the other, the flux will be burned out of the joint before the solder has had an opportunity to flow in and wet both surfaces. Moderate overheating after the silver solder has reached both surfaces of the joint does not seem to affect the joint strength. Heating coils for production operations on the Tocco induction heating machine are generally made of 3/8-inch square brass tubing, and solidly connected to the bus-bars.

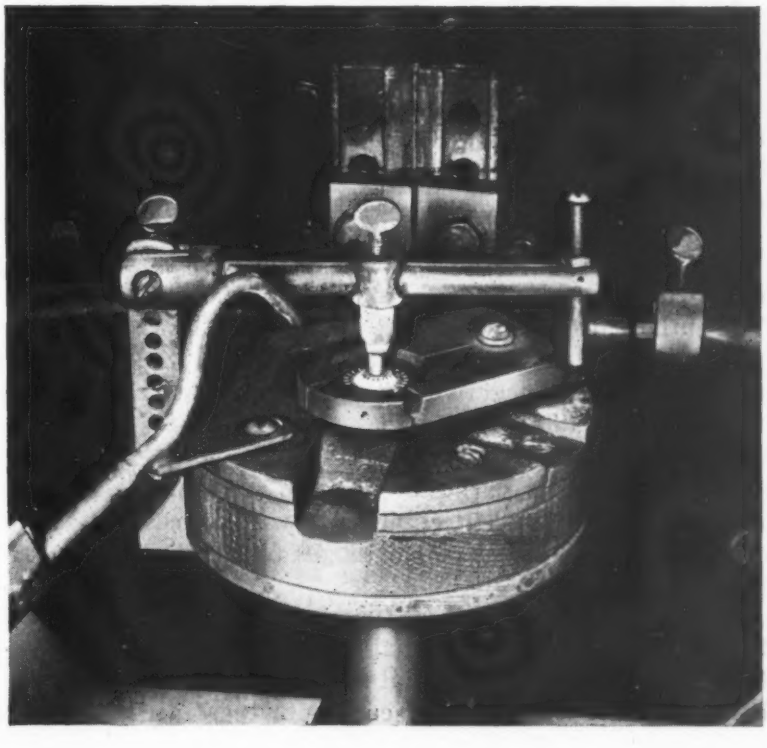


Fig. 16. Two Small Brass Gears are Joined together on an Induction Heating Machine by Providing a Washer of "Sil-Fos" between the Gears. This Brazing Material Contains 80 Per Cent Copper, 15 Per Cent Silver, and 5 Per Cent Phosphorus

Multiple Tapping of Magnesium and Aluminum

(Continued from page 183)

on the right- and left-hand sides. Each taps two holes in the crankcase section and at the same time one of the spindles on the second head at the right comes straight in to tap a fifth hole.

The heading illustration shows the work in the second position, where four holes are tapped on the right- and left-hand sides. Finally, the work is shifted to the third position at the rear for tapping two additional holes by the left-hand spindle head, five by the right-hand head, and twelve by the head at the rear, which moves forward. The work-carriage is indexed into the different positions and returned to the loading position at the front by air pressure.

As the taps used in operations on aluminum and magnesium become dull, they are returned to the tool-room and resharpened on a special machine which provides the hook already referred to. The desired hook is obtained by grinding along the flutes with a formed wheel that revolves counterclockwise, and feeding the tap into the wheel. Because the taps are made without relief on top of the threads, there is little danger of any change in the diameter of the threads produced by them. Taps used for precision work on magnesium require more frequent resharpening than taps used on aluminum, due to the more abrasive nature of magnesium.

After sharpening, the tap teeth are thoroughly cleaned on a motor-driven brush. Then the taps are tested out on a block of aluminum or magnesium in the tool-room to check their cutting performance before they are again released to the shop. This try-out is performed with the tap driven by power on a single-spindle tapping machine without a lead-screw.

A special lubricant mixed in the Buick plant is provided for the tapping operations on aluminum and magnesium. This lubricant consists of four parts of SCO4 to one part of EPC compound obtained from the W. L. Spencer Co. The SCO4 lubricant is a refined mineral oil that is free from acid, soap, resin, or any other substance not derived from petroleum. The flash point of this oil is 320 degrees F., and the fire point, 370 degrees F. The viscosity of SCO4 lubricant at 100 degrees F. is Saybolt 60 minimum and Saybolt 80 maximum.

Radial Rake Angles on Face-Milling Cutters

AT the Chicago local section meeting of the American Society of Mechanical Engineers held June 18 and 19 in conjunction with the semi-annual meeting of the Council of the Society, a paper on "Radial Rake Angles in Face Milling" was presented by J. B. Armitage, vice-president in charge of engineering of Kearney & Trecker Corporation, Milwaukee, Wis., and A. O. Schmidt, research engineer in charge of metal-cutting research of the same organization. The authors drew some definite conclusions from their investigations that should be helpful to those interested in negative-rake milling practice.

"Negative radial rake angles were found to produce stronger cutting tips, the cutting edges of which are generally not so liable to fail from impact and shock when entering a work-piece of hard material as the cutting edges formed by positive radial rake angles.

"Power required at the cutting edge is higher for cutters with negative radial rake angles than for cutters with positive radial rake angles. This holds true for conventional cutting speeds, as well as for higher cutting speeds up to 1180 feet per minute.

"Cutters with negative radial rake angles will stand up longer at the higher speeds than cutters with positive radial rake angles under identical conditions.

"Wear and failure at high speeds on the cutting edge of a cutter with positive radial rake angle will soon increase its power consumption above that of a cutter with negative radial rake angles.

"Average temperature of the chips produced by an ordinary feed does not approach the melting temperature of steel, even at high speeds.

"A cutter with a 15- or 30-degree positive secondary radial rake angle, provided at the cutting edge with a negative primary radial rake angle 1 to 2 times the width of feed per tooth, was found to be a more effective cutter, since it combined the increased strength of the cutting edge afforded by negative radial rake angles and the lower power requirement of the cutter with positive rake angles."

Recent Developments in Boron Steel

The utilization of boron in steel has been under investigation for nearly forty years. Initial studies, however, were concerned with percentages of this element which, although small, produced a steel that was found to be unworkable due to hot-shortness. Eventually these investigations were abandoned.

In more recent years, the work was revived, but on a different basis, the amount of boron being drastically reduced to tiny fractional percentages. The results were most gratifying, for it now developed that as little as 0.0006 per cent of boron produced a distinct increase in the hardenability of steel. The most advantageous proportions were found to be around 0.002 per cent. If this is much increased, hot-shortness begins to appear, and if further increased, the metal becomes so hot-short that it is unworkable.

It appears that boron acts very much like some of the other elements (such as manganese, chromium, nickel, molybdenum, etc.) which are used in the alloy steels to increase hardenability.

Perhaps it might be well to emphasize here that we are speaking of hardenability, not hardness. We are thus concerned only with the depth to which a steel is capable of hardening when quenched.

The principal difference between boron and other alloying elements is that boron seems to have a greater effect, which forces the steel-maker to use exceptionally small proportions, and these small proportions, in turn, require exceptional care to insure equal distribution throughout the metal. Because of such conditions, its introduction in the form of a "master alloy" is even more essential with boron than with some of the better known alloying elements. Several metallurgical firms are marketing boron-content master alloys for steel-makers, and some mills are now producing boron-content steel.—*Archibald Black, in a paper read before the American Society of Mechanical Engineers*

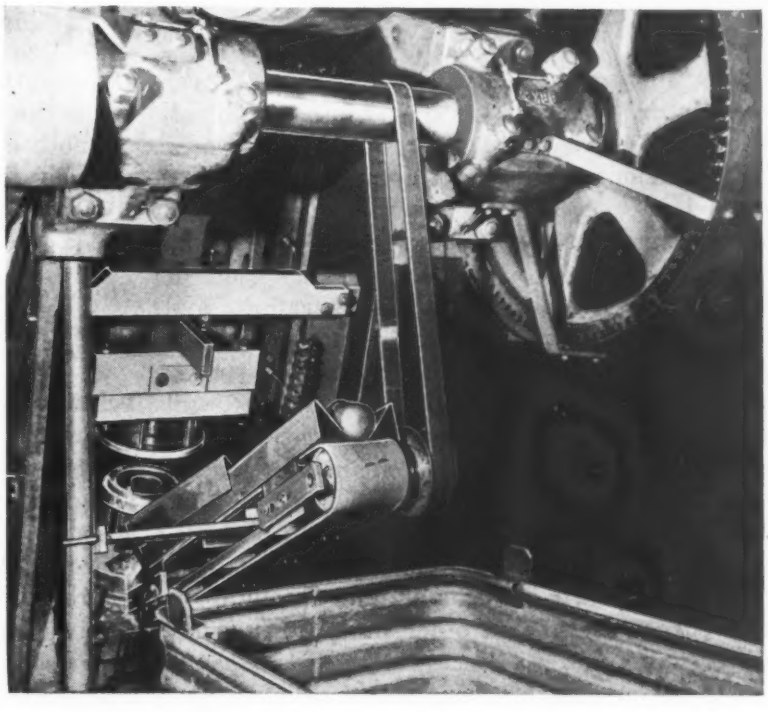
* * *

A Liberty or Victory ship can carry 440 light tanks or 2840 jeeps across the ocean. One of the Maritime Commission standard tankers carries enough gasoline on one voyage across the ocean to supply the holder of an "A" ration book with gas for 35,000 years.

Self-Contained Punch-Press Conveyor

By W. LANIER
Westinghouse Electric Corporation
East Springfield, Mass.

Recently a materials-handling problem was solved very satisfactorily at our plant by adding a small conveyor to the back of a punch press, as shown in the accompanying illustration. This conveyor carries the finished pieces from the die into the skid box, thus cutting down the handling time. The conveyor is belt-driven directly from the shaft at the rear of the press, no motor or gear reduction drive being required. Small studs placed in the conveyor belt serve to catch the pieces and carry them up the steep incline to the container.



Punch Press Equipped with Conveyor Driven by Belt from Press Shaft

* * *

Army and Navy Guide for Contractors

The War and Navy Departments have issued jointly a "Contractors Guide for Prime and Sub-Contractors." This guide contains suggestions for war contractors as to methods of, and advance planning for, settling terminated fixed-price supply contracts with the Army and Navy. Copies can be obtained without charge by written request to the Readjustment Distribution Center, 90 Church St., New York 7, N. Y.

Editorial Comment

The automotive industry is confronted with a most difficult task in undertaking to partly reconvert its factories and secure materials for the production of 215,000 passenger cars this year. The worst bottlenecks, according to Mr. Romney, managing director of the Automotive Council for War Production, are the complex regulatory procedures that have been developed in various government agencies during the period of strict wartime controls over man-power, materials, production equipment, prices, and other phases of the national economy.

Serious Bottlenecks in the Reconversion to Peace Production

The various government agencies are so enmeshed in piecemeal relaxation of rules and regulations, that the effectiveness of the broad policy changes involved in the resumption of production of automobiles, refrigerators, and other civilian goods, is greatly hampered; this also means prolonged periods of unemployment. "Some materials which these industries will require," says Mr. Romney, "are controlled by many different orders, and no one in the agencies or in industry knows of all the controls that must be loosened to make reconversion possible. The specific program authorized by the War Production Board is throwing the spotlight on such governmental and other hindrances to reconversion."

Man-power controls designed to promote stability of employment on war jobs should be discarded now to permit an immediate redistribution of the national working force. Many war industries in which production and employment soared with the war now face cut-backs and unemployment, while other industries, including sheet steel, lead, lumber, and textiles, must quickly increase their output to meet continuing, and in some cases expanding, military requirements and partial reconversion needs. Failure to immediately eliminate present man-power controls will continue the mal-distribution of workers for the job ahead. "The War Production Board" says Mr. Romney, "recognizes its inability to manage the reconversion job from Washington, and other government agencies must follow this example to avoid unnecessary reconversion unemployment."

Government Controls Must Not Hamper Industrial Employment

Among man-power obstacles to reconversion, he pointed to a regulation of the Office of War Mobilization and Reconversion which compels any manufacturer to get approval of the War Man-Power Commission before increasing production above the level prevailing in the fourth quarter of 1944. The statistical information needed to back up such a request is virtually impossible to compile. The net effect of this regulation now is to retard increases in output of essential products and to prolong unnecessarily the unemployment of laid-off war workers.

Another hindrance to reconversion, Mr. Romney says, is the Selective Service's refusal to recognize War Production Board certifications of the essentiality of workers. Local draft boards already are disregarding such certifications in the case of tool and diemakers for reconversion, and there is a similar threat to machine tool builders' employes and to anyone assigned to a reconversion job. Relief from this situation probably will have to come from the Office of War Mobilization and Reconversion.

Industry Can Best Handle its Own Reconversion Problem

Other bottlenecks are the lack of information received by many war contractors from the various military services concerning contract cut-backs and terminations, delay until now of various government agencies in setting up procedures under which private industry can buy government-owned equipment located in their own plants, failure of the Surplus Property Board to establish rules under which manufacturers can purchase government-owned equipment not in their own plants, and difficulties being encountered by manufacturers in getting their own machine tools released from war work when government-owned equipment is available for substitution.

The potential danger to prompt removal of war machinery from automotive factories inherent in the dispute between the AFL and CIO unions over which union's members are to do the work has also been pointed out. "There is ample work for everyone on this emergency job," says Mr. Romney, "and such a trivial dispute should not be permitted to interfere."

Friction in Ball and Roller Bearings

By A. F. BREWER, Technical and Research Division
The Texas Co., New York City

CONSIDERABLE research has been conducted recently on friction in ball and roller bearings. The approach has to be different from the procedure for investigating the friction of plain bearings, since the rolling and sliding friction in ball and roller bearings is quite different in its character from the friction in plain bearings.

Theoretically, sliding friction in a ball and roller bearing should have but little effect on power consumption. In service, however, it may be quite a factor, depending upon the relative speeds of the rolling points. Authorities state that sliding friction is most likely to occur between the balls and the retainers in deep-groove ball bearings, and in roller bearings where the rollers have become skewed. Rolling friction, in turn, has been found to depend upon the size of the balls or rollers; the smaller the diameters, the higher will be the frictional resistance.

Lubrication can, in part, compensate for sliding friction, although the resulting friction due to the energy required to churn or push aside the lubricant may be considerably higher than the normal rolling friction of the bearing elements. For this reason, in the selection for specific applications, emphasis is placed upon the extent to which a grease may develop churning. At low loads, churning may be very objectionable, especially where power consumption is a factor, as in aircraft control bearings at low temperatures or bearings of textile machinery or small electric motors.

Some authorities consider that friction should be expressed in terms of friction torque, this being a more dependable factor than coefficient of friction, since it depends only upon the load and speed.

The amount of lubricant supplied to a bearing also must be carefully considered. An excess can have a definite effect on the frictional resistance. The design and construction of the bearing are also factors. Research has shown that a precision bearing will indicate a slightly higher friction when lubricated than when dry. The opposite is true in a poorly designed bearing.

Briefly, to reduce friction to a minimum, a very small quantity of oil of low viscosity should be used; but the desire to maintain lubrication safely, without regard to friction losses, requires the use of larger quantities of oil of somewhat greater viscosity, in order to reduce losses from evaporation or leakage.

When bearings have to operate in a wide range of temperatures, an oil that shows the least change with change in temperature (that is, an oil with high viscosity index) should be selected.

In the great majority of applications, pure mineral oils are most satisfactory, but they should be free from contamination which may cause wear in the bearing, and they should have a high resistance to oxidation, gumming, and to deterioration by evaporation of light distillates, nor must they cause corrosion of any parts of the bearing, either when idle or in operation. It is self-evident that for very low starting temperatures an oil must be selected that has a sufficiently low pour-point so that the bearing will not be locked by oil frozen solid.

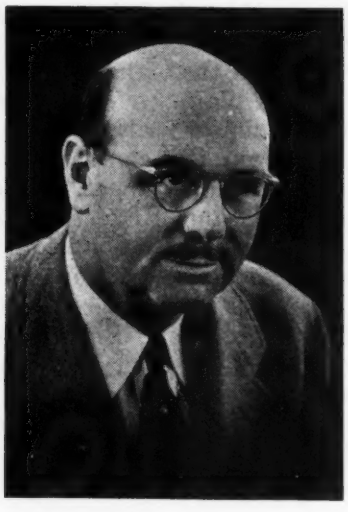
Post-War Use of Molybdenum High-Speed Steels

THERE is a question in the minds of many users of high-speed steel as to the advisability of continuing the use of the molybdenum steels after the war, when the standardized tungsten steels again become fully available. This questioning attitude is due to the fact that the earlier types of molybdenum steels were difficult to heat-treat and to grind. They also had a tendency to spall at the edge when becoming dull. Because of these difficulties with the earlier types of molybdenum steels, a prejudice was created in the minds of many users which persists, though the reasons for it no longer exist.

Molybdenum-tungsten high-speed steels of the 6-6-2 type, more recently developed, present very little difficulty either as regards heat-treatment or grinding. The same controlled-atmosphere furnaces as are used for the regular tungsten steels can be successfully used for these molybdenum steels; with the proper heat-treatment, using such furnaces, no greater difficulties should be met with than in heat-treating tungsten steels. Since the molybdenum steels are appreciably cheaper than the tungsten steels, it is believed by steel manufacturers who handle both types that the molybdenum steels will find increasing application in post-war years and that the unjustified prejudice against these steels will gradually disappear as users become more and more familiar with the new types.

Newly Elected Officers of the Gear Manufacturers Association

(Above Left) President, Paul W. Christensen, President, Cincinnati Gear Co., Cincinnati, Ohio



(Above Center) Vice-president, Thomas J. Bannan, President, Western Gear Works, Seattle, Wash.

(Above Right) Treasurer, Raymond B. Tripp, Vice-president and Sales Manager, Ohio Forge & Machine Corpn., Cleveland

(Left) Executive Secretary, Newbold C. Goin, American Gear Manufacturers Association

How the Automobile Industry will Speed Reconversion

METHODS that saved many months when the automotive industry converted to war production at the beginning of the war will be used again in speeding reconversion and re-employment of automotive workers. The automotive companies are initiating a plan for locating urgently needed machine tools and other industrial equipment. As much as from two to four months' time will be saved by locating machines in this way, as compared with ordering new ones.

Under the plan, any company requiring machine tools that are difficult to obtain may list its needs with the Automotive Council for War Production, which maintains a machine tool listing service. These listings will be circulated at regular intervals among the more than 500 member companies of the Automotive Council. The member companies, in turn, will check these master lists against their own lists of idle or soon-to-be-idle equipment and notify the listing service of any specified equipment that can be spared from war work and is available for purchase. Negotiations for the purchase of such equipment will be handled directly by the companies concerned or by the prospective purchaser and the Government agency that may have title to the machine.

Newly Elected Directors of the Gear Manufacturers Association

(Above Left) Howard Dingle, President of the Cleveland Worm and Gear Co., Cleveland, Ohio

(Above Center) Elmer H. Johnson, Co-partner, Gear Specialties, Inc., Chicago, Illinois

(Above Right) Ernest N. Twogood, Executive Engineer, Gear Division, General Electric Co., West Lynn, Mass.

(Left) Joseph R. Mahan, Chief Engineer, National Supply Co. of Toledo, Ohio

"Pliobond"—A Revolutionary Synthetic Adhesive

A DEMONSTRATION of the exceptional qualities of "Pliobond," a new all-purpose synthetic adhesive developed by the Goodyear Tire & Rubber Co., was recently made in New York City. Pliobond was developed by the Goodyear Research Laboratory in the course of its war program to meet many needs for an unusually strong all-purpose adhesive.

It is claimed that this new material will bond "anything to anything." The application can be made either as a cold-setting cement or under heat or pressure, depending on the requirements. Pliobond is an entirely synthetic compound with resin-like properties, but also with rubber-like characteristics. It belongs to the same family of chemical compounds as synthetic rubbers.

The new material has already been successfully employed for bonding a variety of materials, including metals, plastics, fabrics, vulcanized rubber, paper, leather, glass, plaster, wood, and Portland cement concrete. It is also feasible to bond, by the use of Pliobond, any of these materials to one another.

The new adhesive will be distributed by the United States Plywood Corporation, 55 W. 44th St., New York 18, N. Y.

August Tuechter Completes Sixty Years with the Cincinnati Bickford Tool Co.

ON July 13, 1885, a young man, August H. Tuechter, started to work in the machine tool business of H. Bickford in Cincinnati. This business soon after that was reorganized under the name of the Bickford Drill Co., and in 1887 young Mr. Tuechter was made office manager. Later the company became the Cincinnati Bickford Tool Co., of which August H. Tuechter has been the president for thirty-six years, and with which organization on July 13, this year, he will have completed sixty years of association.

Mr. Tuechter's progress with the organization that he joined so long ago was steady, and his business history and that of the company follow parallel lines. In 1893, when the Bickford Drill Co. was reorganized under the name of the Bickford Drill & Tool Co., he became general manager and partner in the business. In 1899, he entered into partnership with S. C. Schauer, who, for eight years previously, had been superintendent of the Hamilton Machine Tool Co., Hamilton, Ohio. Together they formed the Cincinnati Machine Tool Co., specializing in the building of upright drilling machines, while the Bickford Drill & Tool Co. continued to make radial drills. In 1909, the two companies were consolidated under the name of the Cincinnati Bickford Tool Co., of which Mr. Tuechter then became president.

Mr. Tuechter has always been recognized as one of the leaders in the machine tool industry. He was president of the National Machine Tool Builders' Association from 1920 to 1922, and has always taken a deep interest in its affairs. He has long been a leading figure in industrial activities in Cincinnati, having held many responsible offices with several of the well-known manufacturing companies and banks of that city, as well as with the Ohio Manufacturers' Association, the Industrial Association of Cincinnati, and the National Metal Trades Association. Mr. Tuechter has also taken a prominent part in the philanthropic and welfare work of his community.

During his many years of activity in business, Mr. Tuechter has made an unusual number of friends, both inside and outside of the machine tool industry. He enjoys the friendship and respect alike of employes, business associates, customers, and all others who have come in contact with him.

Government Control Over Industry

BUSINESS will have no right to promise post-war jobs to American workers until it is sure of the elimination of wartime controls which dictate what our factories can make, what prices they can charge, how much they may pay for materials and labor, what materials they may use and where they may buy them, and finally to whom the products of our factories and farms may be sold. Re-establishment of free enterprise in this country cannot be accomplished by the physical removal of an individual in Government or out of it. It can be accomplished, however, by removing the bad ideas which lead to state socialism. The problems at the cross-roads ahead will call for courageous expression and action, and not mere lip service, by all business men who want to maintain a system of free enterprise in the United States. —*Fred E. Schluter, President, Thermoid Co., Trenton, N. J.*

Design of Tools and Fixtures

Double-Action Blanking and Drawing Die for Use in Single-Action Press

A small oval shell with tongues around the outer edge, as shown in Fig. 1, was required to be made to very close limits. The height of the wall between the tongues was important, a tolerance of ± 0.003 inch being given.

As only a single-action press was available, a standard combination blanking and drawing die was first made. This tool stood up for approximately 100,000 pieces before showing signs of wear. However, once the wear had started, irregularities in the shell size began to be noticeable.

As the shell was required in considerable quantities, it would have been costly to continue with this combination type of tool. Therefore,

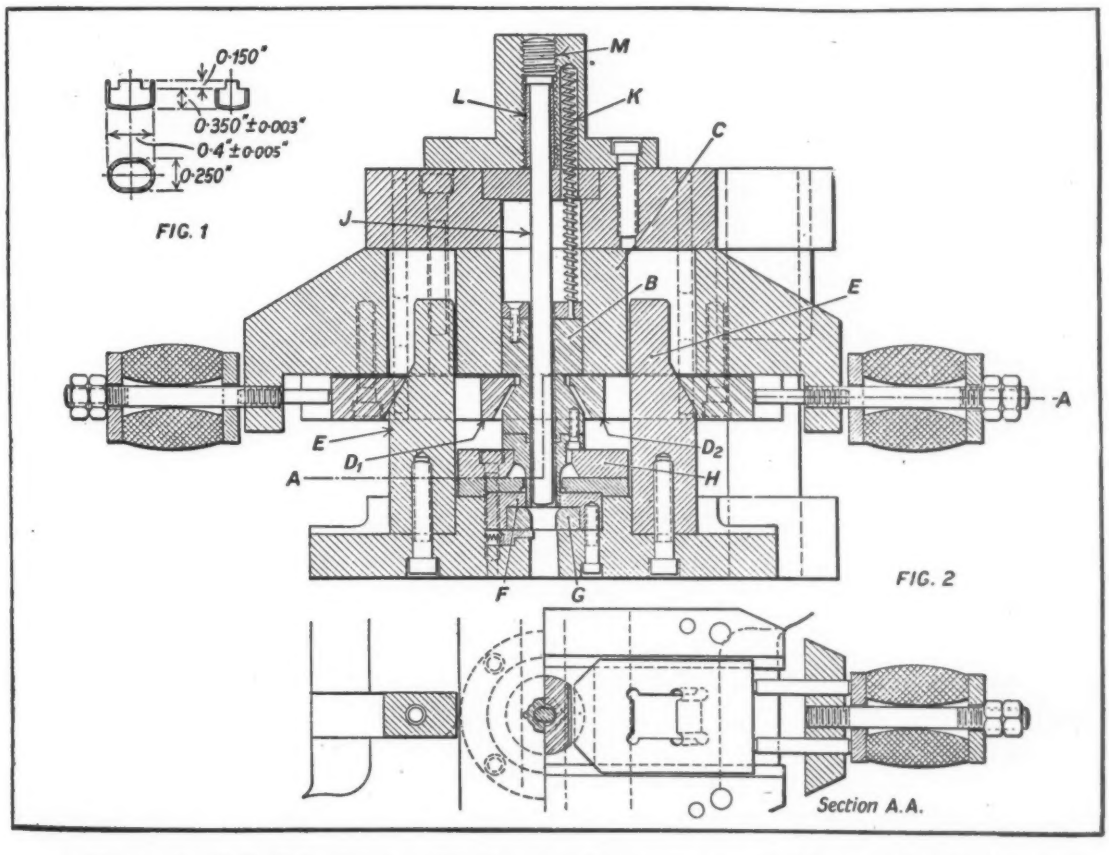


Fig. 1. Small Shell Produced on Die Shown in Fig. 2. Fig. 2. Double-action Die Used on Single-action Press for Production of Shell Shown in Fig. 1

the writer designed the die illustrated in Fig. 2 along the lines of the type of die used in a double-action press.

The blanking punch holder *B* is a sliding fit in a special casting *C* fixed beneath the top plate of a standard die set, and is held in a rigid position during the blanking operation by means of the two slides D_1 and D_2 and the buffers screwed to the sides of the casting *C*. After the blanking operation, as the press ram continues to move down, the slides are forced out by the action of the two vertical cams *E*, thus freeing the blanking punch *B* for the forming operation. The positioning of cams *E* in relation to the blanking punch *B* is very critical, since they must move slides D_1 and and D_2 outward to free the punch-holder *B* while the press ram is traveling downward a distance equal to the thickness of the blanking die *F*, which is only about 3/8 inch.

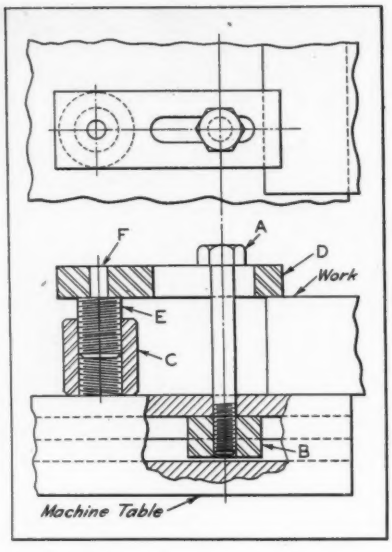
The blanking punch remains stationary during the forming operation and is prevented from coming in contact with the drawing die *G* by means of the ring *H*. This is the position in which Fig. 2 shows the tool. As the ram continues to descend for approximately another 7/8 inch, the center drawing punch *J* forces the blank through the drawing die.

Upon the return stroke, the article is stripped from the punch by means of the three finger strippers beneath the die. The blanking punch *B* is held at rest upon the stop-ring *H* by the pressure of the three springs *K* until the slides D_1 and D_2, released by the cams *E*, slide in and grip the blanking punch, thus raising it from the die and through the stripper into the upper position, ready for the next stroke of the press.

Provision is made for wear of the drawing punch. The sleeve *L* beneath the shoulder of this punch is reduced in height as wear takes place, and the screw *M* in the center of the shank is tightened to grip the upper end of the punch.

This die gave entire satisfaction, and the fact that it was adjustable for wear proved highly advantageous.

A. W. M.



Hold-down Clamp with Height-adjusting Nut C

Adjustable Hold-Down Clamp

By L. C. FRIDDLE
Los Angeles, Calif.

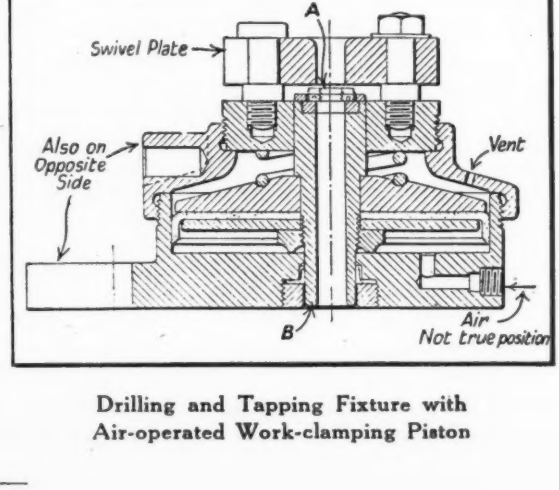
A hold-down clamp of novel design which can be quickly adjusted for clamping work of different heights is shown in the accompanying illustration. The clamp can, of course, be made in different sizes. The particular clamp shown was designed for use with 5/8- or 3/4-inch bolts *A* and T-nuts *B*.

Nut *C*, which provides means for quickly adjusting the height of the clamp *D* to suit the work, is made with a 1 1/8–7 thread, which is a loose fit on the thread of stud *E*. Stud *E* is secured to clamp *D* by a press fit of the machined end *F*. Several nuts *C* of different lengths are provided to cover a wide range of clamping requirements. These nuts have an outside diameter of 2 1/2 inches and are chamfered on each end. The threaded end of stud *E* is 1 5/8 inches long, and clamp *D* is 1 inch thick, 2 1/2 inches wide, and 7 inches long.

Drilling and Tapping Fixture for Disk-Shaped Piece

The simple fixture shown in the accompanying illustration, which is equipped with an air-actuated clamp, was developed for drilling and tapping small disk-shaped pieces like the one shown at *A*. The fixture is provided with a large-diameter cylinder, a piston, and a piston-rod *B*, which supports the work in a locating recess. When air is admitted to the cylinder, the piston-rod rises, clamping the work-piece firmly to the jig plate. A strong spring serves to return the piston to the unloading and reloading position. By changing the recessed bushing that locates the work, the fixture can be adapted to handle a wide range of small parts.

The clamping pressure exerted by the piston on the work is sufficient to prevent it



Drilling and Tapping Fixture with Air-operated Work-clamping Piston

from revolving during the drilling and tapping operations. The jig plate is made to pivot about one of its clamping studs, so that it can be swung clear of the work to facilitate loading and unloading. B. M.

Boring Jig for Worm-Gear Casing

The special cast-iron worm-gear casing shown in Fig. 1, with machined surfaces at *D*, *E*, and *F*, was required to be bored at *A* and to have the ends *B* and *C* of the shaft bearing faced. The boring and facing operations were performed with the desired accuracy on a horizontal boring machine equipped with a jig designed as shown in Fig. 2.

This jig consists of a cast-iron base *G* provided with two tongues *H* which fit the T-slots in the machine table. Tongues *H* serve to position the jig in accurate alignment with the machine spindle. The top of the jig base is recessed to centralize the work by means of the machined hub or shoulder. The base is bored to receive the lower end of the clamping stud *K*, which is held securely in place by a key and nut, as indicated by dotted lines in the upper view, Fig. 2. A pin which is a drive fit in the base of the jig provides accurate radial location of the work.

The work, shown by dot-dash lines, is held in place by a circular clamping plate *M* having a hole at its center which is large enough to clear the hexagonal clamping nut on stud *K*. Plate *M* is fitted with a C-washer which is pivoted on a shouldered screw. This arrangement permits the C-washer to be quickly swung into or away from the clamping position under the hexagonal nut.

Two brackets *N*, secured to the top surface of the jig base, serve to guide the boring-bar during rough- and finish-boring of the worm-shaft hole *A* and the facing of the surfaces *B* and *C*. The brackets *N* are, of course, accurately bored and fitted with guide bushings for the boring-bar.

* * *

"Political promises do not create jobs. Jobs flow from a combination of capital, management, and opportunity, and nothing else. Without these ingredients there can be no jobs."—*Alfred P. Sloan, Jr., chairman, General Motors*

Conference on Baldwin Southwark Strain Gage

Military and industrial engineers recently met for a three-day conference in Washington to exchange information on the uses to which the Baldwin Southwark strain gage has been put in measuring stresses and strains in materials and machinery, and to plan for the application of this knowledge to post-war industrial research. The Baldwin Locomotive Works, Baldwin Southwark Division, sponsored the meeting.

The gage is known as the "SR-4" strain gage. Actual operation of the gage was demonstrated at the meeting. It has provided vital information for improved design of guns, airplanes, ships, and other fighting equipment. For example, by cementing the gage around the barrel of a gun, the amount of strain caused by firing can be recorded. Applied to any part of a bridge, the gage records the impact of moving traffic, showing where the greatest strength is needed in the structure. Research men believe that the wire strain gage will prove useful in determining the strength and efficiency of many of the new and lighter construction materials.

* * *

In 1939, the British Empire had about one-third of the world's ocean-shipping tonnage, and the United States had about one-seventh. Today the United States has a merchant tonnage greater than that of the rest of the world combined; in fact, two-thirds of the world's merchant fleet now flies the American flag.

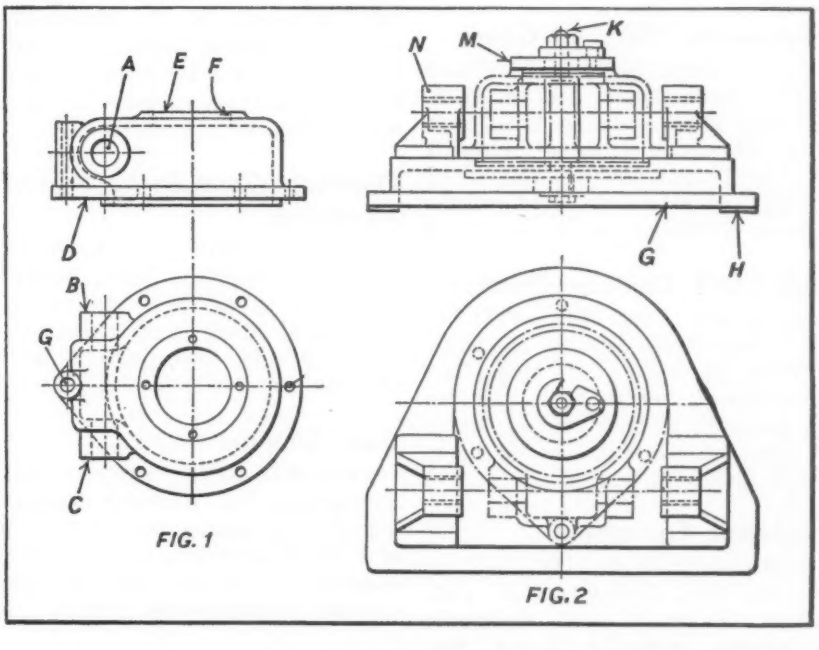


Fig. 1. Worm-gear Casing Requiring Boring of Worm-shaft Hole A and Facing of Ends B and C. Fig. 2. Jig Designed for Boring and Facing Casing Shown in Fig. 1

New Trade Literature

RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To Obtain Copies, Fill in on Form at Bottom of Page 213 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the July, 1945, Number of MACHINERY

Hydraulic Cylinder Calculator

HANNA ENGINEERING WORKS, 1765 Elston Ave., Chicago 22, Ill. Slide-rule "Calculator for Hanna Hydraulic Cylinders," on which nineteen distinct calculations can be performed, including those pertaining to cylinder size, pressure, cylinder speed, size of pump, valves, pipe, and motor. ——1

Precision Holding Tools

ERICKSON TOOLS, DIVISION OF ERICKSON STEEL CO., 2309 Hamilton Ave., Cleveland 14, Ohio. Data sheets containing detailed drawings and specifications of Erickson chucks, precision collets, adjustable floating holders, expanding mandrels, and B & S type adjusting holders. ——2

Engineering Data on Gears

FOOTE BROS. GEAR & MACHINE CORPORATION, Dept. NR, 5225 S. Western Blvd., Chicago 9, Ill. Bulletin (65 pages) entitled "Aircraft Quality Gears," giving engineering data, comparative performance curves, operating speeds, etc. ——3

Hob-Tooth Contour Checker

MICHIGAN TOOL CO., 7171 E. McNichols Road, Detroit 12, Mich. Bulletin 464-45, on the Model 464 "Sine-Line" bench type checker for contours of hobs ranging up to 6 inches outside diameter and up to 8 1/2 inches in length. ——4

Electronic Equipment

WALKER-JIMIESON, INC., 311 S. Western Ave., Chicago 12, Ill. Catalogue on radio and electronic equipment, covering X-ray machines, photo-electric devices, electronic comparators, die-less duplicating tools, etc. ——5

Strain Gage

BALDWIN LOCOMOTIVE WORKS, BALDWIN SOUTHWARK DIVISION, Philadelphia 42, Pa. Bulletin 179, on the SR-4 bonded resistance-wire strain gage used for measuring strains in all kinds of engineering designs and structures. ——6

Motorized Speed-Reducing Units

PHILADELPHIA GEAR WORKS, INC., Erie Ave. and G St., Philadelphia 34, Pa. Catalogue MR-45 (52 pages), describing this company's entire line of self-contained motorized speed-reducing units. ——7

Industrial Rubber Products

MANHATTAN RUBBER MFG. DIVISION OF RAYBESTOS-MANHATTAN, INC., Passaic, N. J. Condensed catalogue entitled "Manhattan Rubber Products for Industry," including belting, hose, packing, abrasive wheels, etc. ——8

Oilproof Vibration-Absorption Mountings

BUSHINGS, INC., 3442 W. Eleven Mile Road, Berkley, Mich. Bulletin BU-34, on synthetic insulating aircraft cowl mountings, impervious to oil. Similar mountings are suitable for other industrial uses. ——9

Gear Shapers

FELLOWS GEAR SHAPER CO., Springfield, Vt. Circular illustrating and describing the application of Fellows automatic indexing gear shapers to cutting internal and external straight-sided splines. ——10

Bearing Bronze

BEARIUM METALS CORPORATION, 278 State St., Rochester, N. Y. Folder describing unusual frictional properties of Bearium metal, suitable for bearings, bushings, thrust washers, and other parts involving rubbing friction. ——11

Blast Cleaning

AMERICAN FOUNDRY EQUIPMENT CO., Mishawaka, Ind. Catalogue (24 pages) on the "Wheelabrator," a mechanical unit that utilizes centrifugal force instead of compressed air for abrasive blast cleaning. ——12

Carbide-Tipped Gages

YANKEE PRECISION PRODUCTS CO., 595 New Park Ave., Hartford 10, Conn. Bulletin 4-45-2, descriptive of "Roundtest" carbide-tipped plug gages, "Renewlife" limit gages, and "Handi-Blox" carbide-tipped size-blocks. ——13

Die-Holders, Centers, and Measuring Wires

ARC PRECISION TOOL CORPORATION, 416 Broadway, New York 13, N. Y. Bulletin on self-releasing die-holders, regular and live lathe centers, and thread measuring wires. ——14

Screw-Machine Tools

BOYAR-SCHULTZ CORPORATION, Walnut St. at Hoyne, Chicago 12, Ill. Bulletins on screw-machine tools for turning extra small parts; turning tools of large capacity; and floating tool-holder. ——15

Electric Equipment

GENERAL ELECTRIC CO., Schenectady 5, N. Y. Bulletin GEA-4131, on motors and control for hazardous locations. Bulletin GEA-4324, descriptive of G-E electric tachometers. ——16

Air-Hardening Tool Steels

CARPENTER STEEL CO., 105 W. Bern St., Reading, Pa. Folder describing three air-hardening tool steels, and explaining the Matched Set Method of selecting the steel that is best suited for each particular job. 17

Hydraulic Material-Handling Equipment

LYON-RAYMOND CORPORATION, 2207 Madison St., Greene, N. Y. Bulletin 139, descriptive of Lyon-Raymond hydraulic trucks, elevating tables, pumps, etc. 18

Automatic Temperature Control Equipment

PRECISION SCIENTIFIC CO., 1750 N. Springfield Ave., Chicago 47, Ill. Catalogue 325, on "Precision-Freas" constant-temperature control cabinets and ovens. 19

Leather Packing Design Data

CHICAGO BELTING CO., Green and Washington Sts., Chicago 7, Ill. Text-book and catalogue on the "Design and Application of Hydraulic and Pneumatic Leather Packings." 20

Manganese Steel

AMERICAN MANGANESE STEEL DIVISION, AMERICAN BRAKE SHOE CO., Chicago Heights, Ill. Bulletin 1144-NM, describing non-magnetic applications of Amsco manganese steel. 21

Resin Coatings

BAKELITE CORPORATION, 30 E. 42nd St., New York 17, N. Y. Bulletin on resin coatings baked by induction heating, giving detailed information. 22

Ampcoloy Bronzes

AMPCO METAL, INC., Milwaukee 4, Wis. Bulletin 59, describing Ampcoloy bronze alloys—their properties, compositions, and applications. 23

Electrodes

AIR REDUCTION, 60 E. 42nd St., New York 17, N. Y. Catalogue of 56 pages covering electrodes and containing a great deal of reference information on welding. 24

Sintered-Alnico Magnets

GENERAL ELECTRIC CO., Schenectady 5, N. Y. Bulletin GEA-3682B, descriptive of sintered-Alnico permanent magnets, containing a list of standard G-E forms. 25

Diesel-Engine Oils

E. F. HOUGHTON & CO., 303 W. Lehigh Ave., Philadelphia 33, Pa. Circular outlining the properties and applications of Houghton's "Vital" diesel-engine oils. 26

Automatic Screw Machines

GEORGE SCHERR CO., INC., 199 Lafayette St., New York 12, N. Y. "Precise Production," No. 107, featuring Gibbs Swiss type automatic screw machine. 27

Cleaning Materials

OAKITE PRODUCTS, INC., 26 Thames St., New York 6, N. Y. Booklet on "Oakite Tri-San," a deodorizing, cleaning, and disinfecting material. 28

Die-Less Duplicating

O'NEIL-IRWIN MFG. CO., 332 Eighth Ave. S., Minneapolis 15, Minn. Catalogue 45-8, containing forty pages of data on the Di-Acro system of "die-less" duplicating. 29

Marking Devices

NEW METHOD STEEL STAMPS, INC., 147 Jos. Campau St., Detroit 11, Mich. Catalogue on hand and machine marking devices, including type, dies, etc. 30

Blast Cleaning

PANGBORN CORPORATION, Hagerstown, Md. Publication entitled "Impact," (No. 1, 1945) featuring "The Pratt & Whitney Story," and "Shot Peening." 31

Milling Machines

MODERN TOOL WORKS LTD., Montcalm Ave., York Township, Toronto, Canada. Bulletin 205, on universal and plain horizontal milling machines. 32

Machine Tools and Accessories

FRAY MACHINE TOOL CO., Glendale 4, Calif. Price list No. 16, on milling machines and attachments, back-gear units, offset boring heads, and accessories. 33

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Stock Adjusting Machines

WATSON-STILLMAN CO., Roselle, N. J. Bulletin 540-A, on Walter stock adjusting machines for lengthening, straightening, or shortening locomotive parts. 34

Projection Welding

OHIO NUT & BOLT CO., Berea, Ohio. Manual containing technical data on projection welding and its application to nuts, bolts, and similar threaded products. 35

Magnetic Lathe Chucks

MAGNETIC HOLDING DEVICES, INC., 2034 E. 22nd St., Cleveland 15, Ohio. Circular illustrating and describing the new "Body Flo" magnetic lathe chuck. 36

Materials-Handling Equipment

LEWIS-SHEPARD PRODUCTS, INC., 288 Walnut St., Watertown 72, Mass. Folder on shop trucks and other materials-handling equipment. 37

Welding for Maintenance

LINCOLN ELECTRIC CO., Cleveland 1, Ohio. New edition of a booklet entitled "101 Welding Ideas for Low-Cost Maintenance." 38

Eutectic Welding

EUTECTIC WELDING ALLOYS CO., 40 Worth St., New York 13, N. Y. Circular descriptive of the eutectic low-temperature welding process for repair and maintenance. 39

Machining Die-Castings

NEW JERSEY ZINC CO., 160 Front St., New York 7, N. Y. Book entitled "Practice in Machining Zinc-Alloy Die-Castings." 40

Radii and Angle Dressing Tools

J & S TOOL CO., East Orange, N. J. Catalogue describing "Fluid-Motion" radii and angle dressers for form-dressing. 41

Tapping Machines

DETROIT TAP & TOOL CO., 8432 Butler St., Detroit 11, Mich. Bulletin MTM-45, on medium-duty tapping machines. 42

Electric Type Controllers

BRISTOL CO., Waterbury 91, Conn. 16-page bulletin describing "Microact" and other electric type Pyromaster controllers. 43

Flash Welding

AMERICAN WELDING & MFG. CO., Warren, Ohio. Circular entitled "Flash Welding—A Solution to Assembly of Forged Parts." 44

Back Spot-Facers

EDLUND TOOL CO., 4473 Woodward Ave., Detroit 1, Mich. Bulletin BSF445, on offset back spot-facers. 45

Cutting Alloy

JESSOP STEEL CO., Washington, Pa. Booklet on Jessop "T and V" cast-to-shape cutting alloy. 46

Self-Lubricating Bearings

MORGANITE BRUSH CO., INC., Long Island City 1, N. Y. Bulletin entitled "Self-Lubricating Bearings for Today's Requirements." 47

Electro-Mechanical Products

LEAR, INC., Department 81, Piqua, Ohio. 226-page catalogue on the Lear line of aviation electrical and mechanical products, including specifications, installation drawings, tabulated charts, load and performance curves, and other design data for engineers. Copies will be sent to engineers or product designers if requested on a firm letter-head.

Friction Materials for Industrial Machinery

RAYBESTOS - MANHATTAN, INC., EQUIPMENT SALES DIVISION, Passaic, N. J. Catalogue descriptive of friction materials for industrial machinery of all types. Designers and manufacturers of brakes and clutches can obtain copies by addressing the company directly.

Vibration Control

KORFUND CO., INC., 48-15 Thirty-second Place, Long Island City 1, N. Y. Catalogue H-600, describing Korfund vibration control for drop-hammers, punch presses, and similar machines. Copies can be obtained by sending a request on a company letter-head directly to the manufacturer.

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 214A-244 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in July, 1945, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York 13, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Reed-Prentice Vertical Milling Machine with Electronic Feed Drive

A new No. 4 vertical milling machine, equipped as shown in Fig. 1 with electronic feed drive for the table, cross-slide, and vertical spindle-head slide, has been brought out by the Reed-Prentice Corporation, Worcester 4, Mass. The electronic drive is controlled by the centralized push-button station shown in Fig. 2.

Centralized operating levers are all positioned within easy reach of the operator. Two sets of levers, each consisting of an airplane type half handwheel and a ball-grip lever, are provided. The half handwheel control gives an infinitely variable feed rate in either direction. The further the handwheel is moved from the central or neutral position, the higher the feed rate becomes. This arrangement is similar to a Servo control, and allows the operator to move the table or slides with practically no effort. The five-position ball-grip levers provide feed and rapid traverse in either direction. The feed rate is constant, preselected, and controlled by the adjustment of the potentiometers located on the push-button station.

An important feature of this machine is that it enables the operator to set the feed rate by simply adjusting the potentiometer knobs. This permits finding the most efficient feed while the cutter is in action. The table, cross-slide, and vertical spindle-head slide are driven by three 1 1/2-H.P. direct-current motors with electronic control, which provides infinitely variable feed rates. The electronic units provide full-wave rectification armature control for motor speeds below 1330 R.P.M., and field control for motor speeds above 1330 R.P.M.; reversing; overload and under-voltage protection; armature voltage drop compensation to maintain speed within close limits regardless of load fluctuation; and dynamic brake stop for any speed to prevent coasting.

There are two electronic units for the control of the three motors, one controlling the table motor, and the other the cross-slide and vertical spindle-head slide motors. Shifting of the latter unit from one motor to the other is accomplished by means of a selector switch mounted on the push-button control station. The electronic units are mounted on a hinged panel and enclosed in a dust-tight sheet-metal box. A blower, mounted on the inside of this box, insures satisfactory heat dissipation by providing continuous air circulation within the box to prevent overheating.

Identical control systems are furnished for the table and the cross-slide and vertical slide. The group of controls seen at the right when facing the machine is for the table, and the control on the left is for the slides. Electrical interlocks are provided with these controls as a safeguard against possible errors by the operator in manipulating the controls.

The rapid-traverse mechanism is driven by two 3-H.P. alternating-current motors, one for the table and one for the cross-slide. Conventional magnetic reversing control, plugging switches, and five-position power-feed lever control are provided for these motors. A

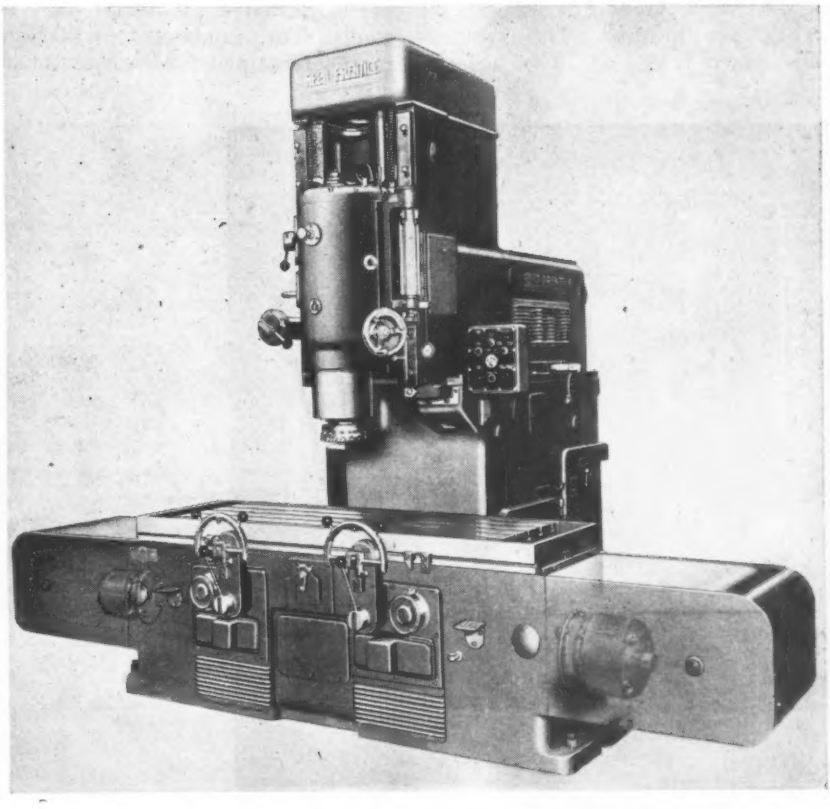


Fig. 1. Reed-Prentice Vertical Milling Machine Equipped with Electronic Drives for Table and Slide Feeds

To obtain additional information on equipment described on this page, see lower part of page 214.

clutch disengages the direct-current motor from the feed-screw when the rapid-traverse alternating-current motor is energized. This clutch is operated by the power-feed lever. At the same time, the power-feed lever operates the cam type master control switch, which disconnects the direct-current motor and energizes the alternating-current motor. These electrical interlocks and positive mechanical controls are provided to prevent the alternating-current motor from driving the direct-current motor while the rapid-traverse drive is engaged. However, the clutch and control switch are so arranged that the direct-current motor drives the alternating-current motor when the feed is engaged.

The spindle is driven by a 10-H.P., 1200 R.P.M. motor. However, the capacity of the machine is such that a 20- or a 30-H.P. motor can be employed for heavy milling operations with negative-rake milling cutters.

The table has a working surface of 24 by 84 inches. The longitudinal travel of the table is 48 inches, and the feed is infinitely variable from 1/2 inch to 26 inches per minute. The cross-slide has a travel of 23 inches and infinitely variable feed from 1/4 inch to 20 inches per minute. The vertical slide has a travel of 12 inches.

There are eighteen spindle speeds ranging from 30 to 1200 R.P.M. Power rapid traverse for the table is at the rate of 180 inches per minute, and for the cross-slide 120 inches per minute. The complete machine has a weight of 20,500 pounds. ---------- 51

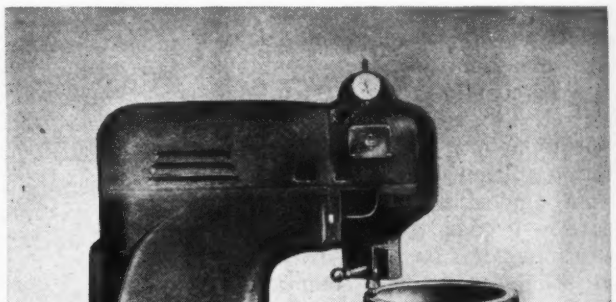
Hanchett Comparator for Accurately Determining Grade of Abrasive Wheels

A comparator that offers the user of grinding wheels and other abrasive products a simple but accurate means for checking abrasive hardness and bond structure has been placed on the market by the Hanchett Mfg. Co., Big Rapids, Mich. With this comparator, wheels can be double checked for grinding characteristics before they are mounted on the machines, thus making it possible to maintain uniform finish on high-production runs of precision work with a minimum loss of time. The comparator also simplifies the selection and replacement of grinding wheels and hones by the operator who is required to duplicate the finish on precision parts, eliminating slow hand or cut-and-try methods.

Operation of the comparator is a simple matter. A diamond or special alloy-steel grading tool oscillating under a given load gradually penetrates the grinding wheel or other abrasive material to be graded. The number of oscillations is predetermined for each material, based on comparative tests made on wheels, hones, or material previously proved satisfactory. When the instrument completes its specified number of oscillations, the grading tool records the depth of penetration within 0.001 inch on an indicator. Thus, grinding wheels of exactly the same hardness and bond structure can be classified and segregated according to degrees of hardness, and their performance predetermined.

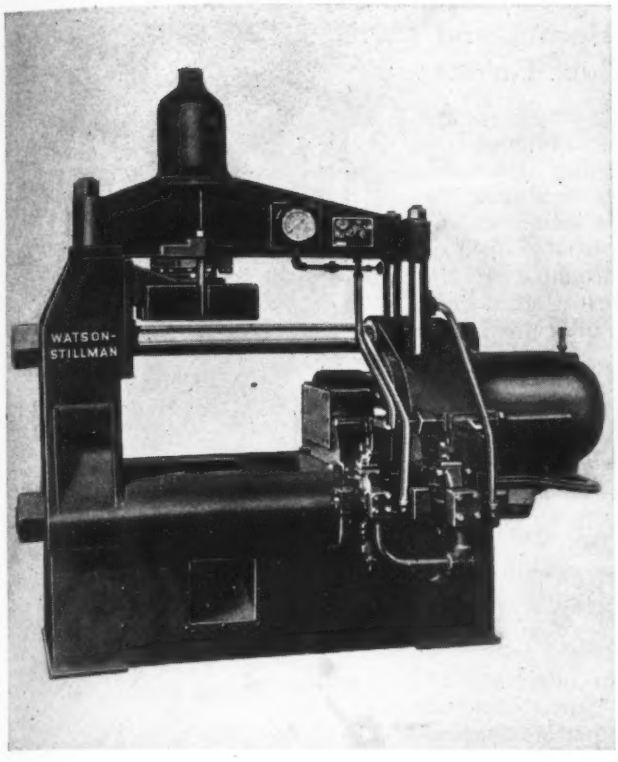
The comparator has a rigid vibration-proof base and a rectangular work-table, 15 by 22 inches. Maximum work height of the regular comparator is 6 inches, but larger sizes can be furnished. The table is adjustable vertically by a handwheel to obtain the proper work setting. A lever serves to raise and lower the tool. This permits repositioning of work without changing the table setting. The timer, set for the required number of oscillations, automatically stops the comparator on completion of its cycle. ---------- 52

Fig. 2. Centralized Push-button Control Station of Vertical Machine Shown in Fig. 1

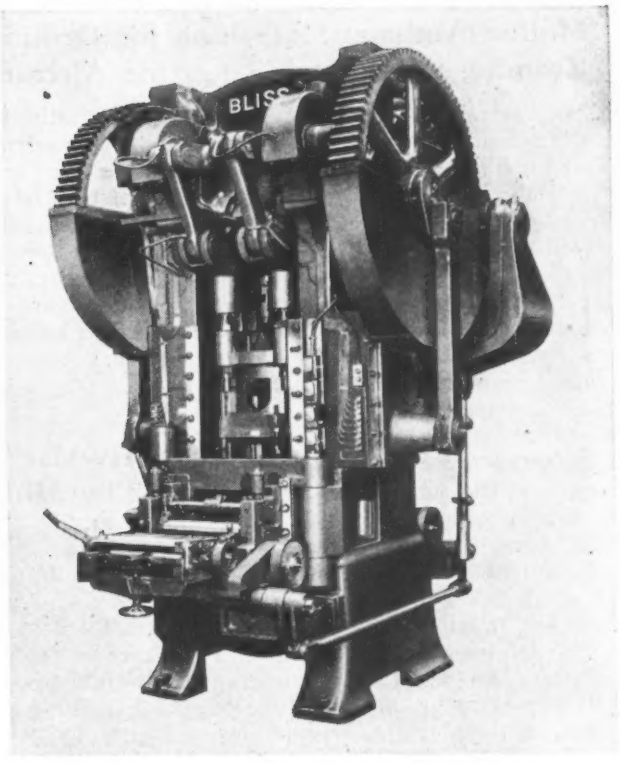


Hanchett Comparator for Accurately Grading and Matching Grinding Wheels

To obtain additional information on equipment described on this page, see lower part of page 214.



Angle Molding Press Brought out by the Watson-Stillman Co.



Bliss Toggle Press that Automatically Blanks and Draws Parts from Coiled Stock

Watson-Stillman Angle Molding Presses

For molding plastic products requiring split molds and for molding complicated parts by the transfer method, the Watson-Stillman Co., Roselle, N. J., has brought out two newly designed angle molding presses. An outstanding feature of these machines is the elimination of manual handling of split mold sections, which reduces maintenance cost for such molds and at the same time, increases the rate of production.

These presses are of all-steel construction, except for the rams, which are close-grain cast iron. The self-contained radial piston pumping unit driven by a fully enclosed motor can be placed on the floor in any desired location. Automatic single-cycle operation from a push-button panel can be supplied if desired. This system incorporates all adjustments for operation of the machine in accordance with a predetermined automatic cycle.—53

Bliss Automatic Toggle Press

The E. W. Bliss Co., 53rd St. and First Ave., Brooklyn 32, N. Y., has recently built and equipped a No. 3 1/2-B Bliss toggle drawing press for automatically blanking and drawing parts from coiled brass or steel stock at the rate of 15 strokes per minute. The stock is fed from the coil through a seven-roll straightener to remove the curvature due to coiling. The press is equipped with a precision double roll feed, which has a maximum feed length of 18 inches and will feed stock up to a maximum width of 18 inches. An automatic stock oiler is attached to the feed to provide adequate lubrication.

A shear type scrap cutter is also furnished. The scrap cutter is furnished with a spring-actuated hold-down and tool-steel blades. Incoming feed rolls and the straightening unit are mounted on a vertical pivot, so that they can be swung out of the way to permit inserting the press dies. Since, in a double-action press of this type, only a comparatively short part of the cycle is available for feeding, elliptical gears are employed for driving the feed and scrap cutter.

The No. 3 1/2-B straight-side single-crank toggle press is built with a four-piece steel tie-rod frame construction. It is equipped with twin driving gears on the crankshaft. A twin drive is also furnished on the blank-holder. A Bliss pneumatic friction clutch with electric push-button control and an air brake for stopping the flywheel are also furnished. Both flywheel and drive-shaft are mounted on Timken roller bearings.

The plunger capacity of the press at the bottom of its stroke is 125 tons. The stroke of the punch slide is 15 1/2 inches, and work can be drawn to a depth of 7 inches. The crankshaft is 6 inches in diameter at the main bearings, and is increased to a diameter of 6 1/2 inches at the crankpin. The blank-holder slide has a stroke of 10 inches. There is a 4-inch adjustment of the blank-holder and punch slide. The distance from bed to blank-holder slide, with the ram down and the adjustment up, is 22 inches, and the distance from bed to punch slide, with the ram down and the adjustment up, is 22 inches. There is a distance of 26 inches between uprights, and the blank-holder will accommodate blanks up to 20 by 20 inches.—54

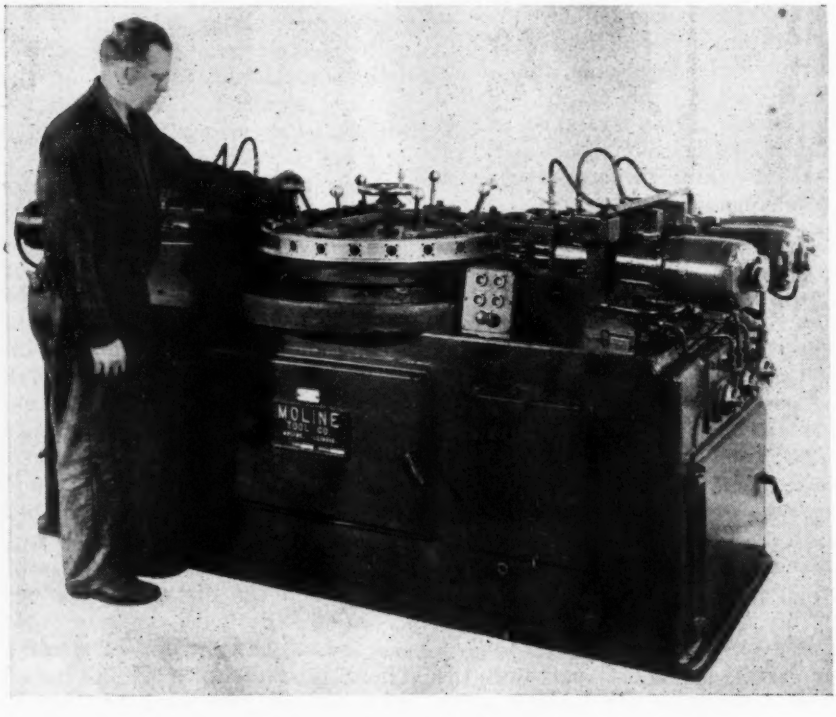
To obtain additional information on equipment described on this page, see lower part of page 214.

Moline Automatic Machine for Drilling, Boring, and Reaming Aluminum Rings for Aircraft Gun Turrets

The special M32 completely automatic machine shown in the accompanying illustration is one of several designs produced by the Moline Tool Co., Moline, Ill., for work on aircraft gun turret rings. This machine has many features that are applicable to machining problems met with in the production of a variety of metal parts. The illustration shows the machine equipped for automatically drilling and reaming twenty-four groups of four small holes in the aluminum ring. At the same time this work is being performed, the machine finish-bores and chamfers a larger hole at the center of each group of small holes which was drilled during a previous operation.

The equipment of this machine includes two four-spindle drilling units, two four-spindle reaming units, and two single-spindle precision boring units. Each unit has its own hydraulic feed cylinder and feed-rate regulating valve.

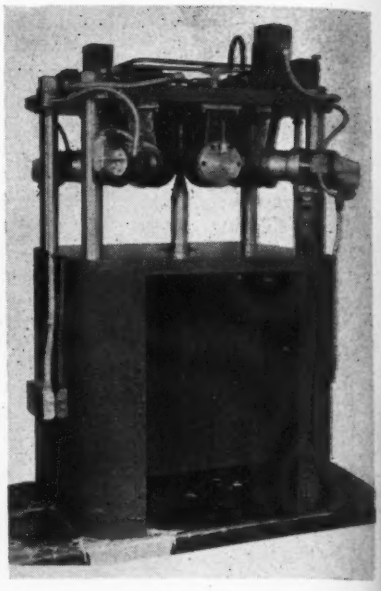
Complete automatic electric control renders skill on the part of the operator unnecessary, since all he has to do is to load and unload the work and press the button to start the automatic operating cycle. During this cycle, the work is indexed automatically by hydraulic power to bring each group of holes into the proper machining positions. Complete safety interlocking of the electrical, mechanical, and hydraulic functions prevents trouble such as might occur, for example, if the reamers were fed into the work where no holes had been previously drilled. ---------- 55



Special Machine Built by Moline Tool Co. for Drilling and Reaming Operations on Aluminum Rings for Aircraft Gun Mounts

"Hy-Mac" Machine for Drilling Holes and Inserting Pins in Shell Nose

A special-purpose machine that drills four holes through the assembly of the nose and body of the 60-millimeter shell and then presses a 0.090-inch brass pin into each of the drilled holes has been completed recently by Hydraulic Machinery, Inc., 12825 Ford Road, Dearborn, Mich. All the movements of the machine members during the operating cycle are controlled pneumatically and electrically, an air cylinder being used to position the shell for drilling. The four holes are drilled simultaneously with four self-contained electric drill heads spaced 45 degrees apart.



Machine for Drilling Four Holes in Shell Nose and Inserting a Pin in Each Hole

Upon completion of the drilling operation, the heads return to the starting position. By means of a switch, connecting in series on each head, contact is made with a solenoid operating valve, which causes the shell to be indexed to an angle of 45 degrees. A pressure switch then completes the cycle, allowing the air cylinder to move forward, which, in turn, presses the pins into the drilled holes. When the air cylinder returns to the starting position, the positioning ram is withdrawn and the shell is unloaded. Each pin loading station is equipped with a magazine, and the pins are automatically fed by the movement of the pin pressing cylinders. ---------- 56

Arc-Welding Electrode for Low-Alloy, High-Tensile Steels

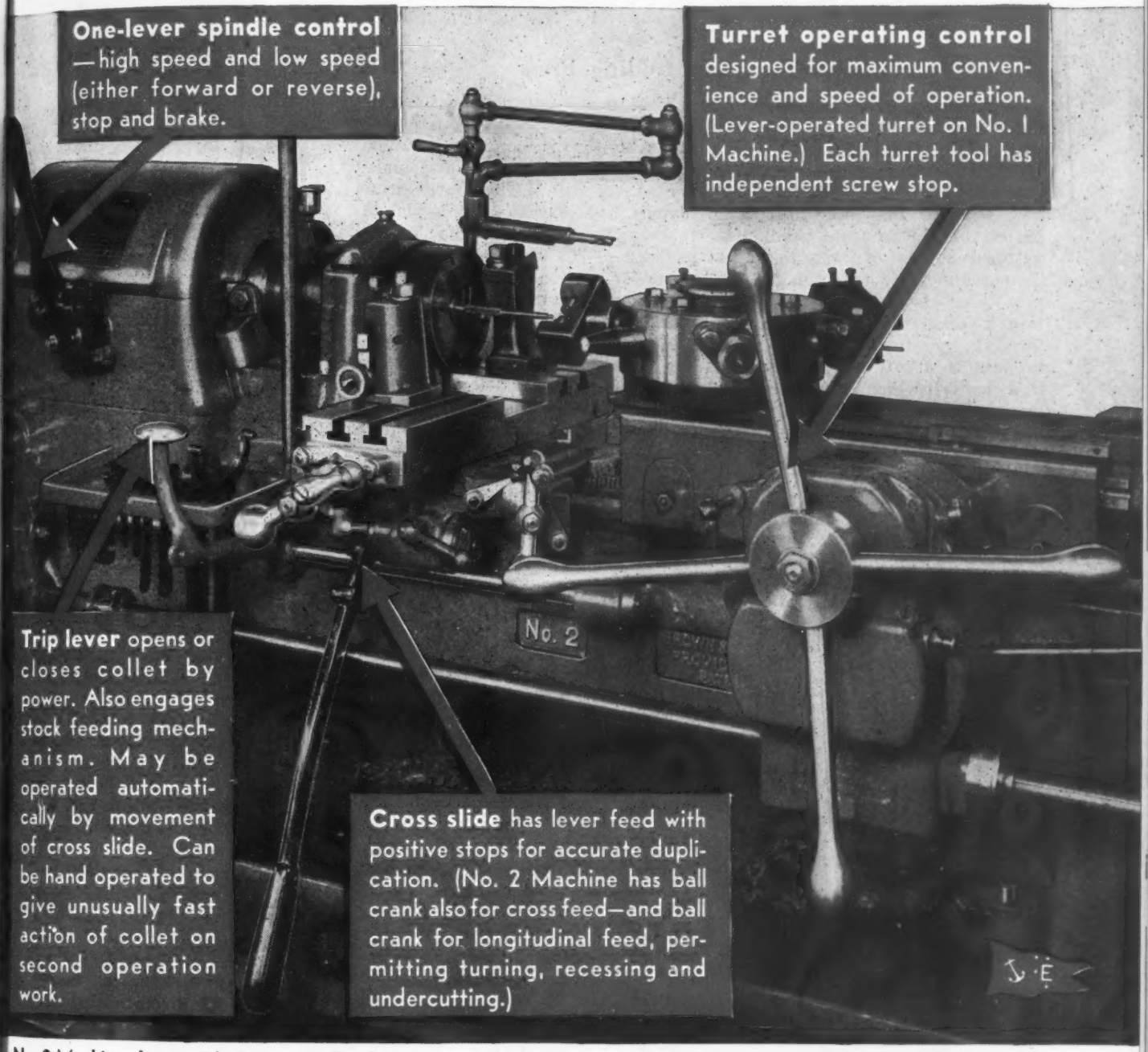
A heavily coated arc-welding electrode for welding low-alloy, high-tensile steels has just been brought out by the Electric Welding Division of the General Electric Co., Schenectady 5, N. Y. This electrode is especially designed for use on carbon-molybdenum steel in the high-pressure piping industry, and can also be applied to a great variety of containers (fittings) and structural weldments. It is known as Type W-56, operates satisfactorily on either alternating or di-

To obtain additional information on equipment described on this page, see lower part of page 214.

SIMPLE CONTROLS — FAST OPERATION

Give Maximum Production

on Bar Work and Second Operations



One-lever spindle control —high speed and low speed (either forward or reverse), stop and brake.

Turret operating control designed for maximum convenience and speed of operation. (Lever-operated turret on No. 1 Machine.) Each turret tool has independent screw stop.

Trip lever opens or closes collet by power. Also engages stock feeding mechanism. May be operated automatically by movement of cross slide. Can be hand operated to give unusually fast action of collet on second operation work.

Cross slide has lever feed with positive stops for accurate duplication. (No. 2 Machine has ball crank also for cross feed—and ball crank for longitudinal feed, permitting turning, recessing and undercutting.)

No. 2 Machine shown with Automatic Feed for Turret Slide—an extra which further speeds production on turning long lengths.

Write for booklet completely describing these modern versatile screw machines.

B·S BROWN & SHARPE MFG. CO.
Providence 1, R. I., U. S. A.

Accurate-Efficient-Profitable
Nos 1 and 2 Wire Feed
Screw Machines

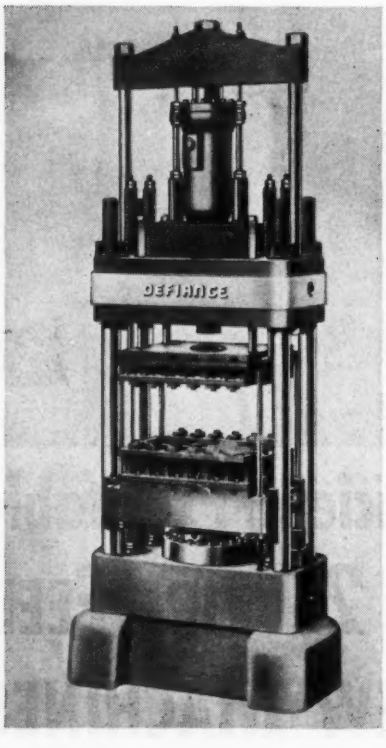
BROWN & SHARPE

rect current, reverse polarity, and has a current range sufficiently broad for use on a wide range of plate thicknesses.

Features of the new electrode include a stable spray type arc, deep penetration, and excellent creep-resisting qualities. The electrode covering produces an easily removable light friable slag. This electrode is available in diameters of 1/8, 5/32, and 3/16 inch. It meets the requirements of American Welding Society Classes E7010-E7011, and the Navy Bureau of Ships specifications 46E2. ——— 57

Plastic Transfer Molding Press

A plastic transfer molding press, designated No. 152, has been announced by the Defiance Machine Works, Inc., Defiance, Ohio. This machine has been designed with new features that are claimed to permit highly accurate production with a reduction of waste material. Transfer molding with this type of press consists essentially of injection molding of thermosetting materials, the mold charge being brought to a soft plastic condition in a chamber which is built into the machine and is separated from the mold. In this plastic condition, the material is transferred or injected into the mold through a single opening. After the mold has been completely filled with the material, the application of heat and pressure is continued for a sufficient period to permit a complete cure or polymerization in the molded part.



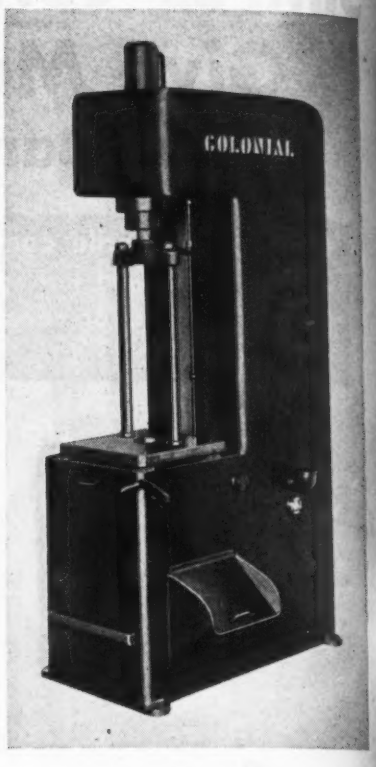
Defiance Plastic Molding Press

This press is double-acting in principle and is designed to operate from an accumulator system using pressures up to 3000 pounds per square inch. There are three platens, the lower or main platen that moves upward, the intermediate or floating platen, and the upper or stationary platen, which is adjustable vertically in 2-inch increments. The transfer pot is centered in the floating platen, and is held in place when the upper half of the mold is fastened to this platen. (The pot is not bolted or fastened to the mold.) After the pot is loaded, the lower platen, which carries the lower half of the mold, moves upward closing the mold under low pressure. Maximum working pressures of 3000 pounds per square inch exert a mold clamping pressure of 170 tons through the main ram.

Maximum mold width is 18 inches, maximum length 26 inches, and minimum working space or "daylight" between platens 15 inches, which can be increased by increments of 2 inches up to 23 inches. The platen has a stroke of 15 inches. With the upper platen in the highest position, the maximum height of the mold is 13 1/2 inches, and with the upper platen at the lowest adjustable position, the minimum mold height is 5 1/2 inches. Pots and plungers can be supplied in four different bore diameters ranging from 3 1/4 to 4 3/4 inches. ——— 58

Colonial Pull-Broaching Attachment for Hydraulic Presses

The utility broaching presses made by the Colonial Broach Co., Box 37, Harper Station, Detroit 13, Mich., are now available with a pull-down attachment which makes them suitable for pull- as well as push-broaching. The increase in flexibility thus provided is particularly useful where extreme broaching accuracy is required or where the broaches are too small to be pushed through the work.



Colonial Utility Press with Pull-down Attachment

The attachment has two vertical guide rods held together at the top and bottom with tie-bars. The lower tie-bar of the attachment carries a puller adapter designed to permit the use of automatic pullers. Hardened and ground bars are employed for guiding the broach to assure accurate alignment, and the guides slide along bushings pressed into the platen bed.

The attachment is available on the full line of Colonial utility presses ranging from 4 to 10 tons rated capacities. Strokes of these presses range from 24 to 36 inches. These stroke capacities can be reduced to suit requirements by employing stops. ——— 59

Micro-King Borlocator

Steel Tools, Inc., 2307 Prospect Ave., Cleveland, Ohio, has brought out a Model D "Micro-King" Borlocator set consisting of over 1000 precision "Micro-King" parts, all contained in one cabinet, ready to be assembled into jigs or fixtures to meet the requirements for drilling accurately positioned holes or

To obtain additional information on equipment described on this page, see lower part of page 214.

MORE JOBS

THAN YOU CAN THINK OF

It is a long list of jobs that a Cincinnati Press Brake will do . . . forming, progressive forming, corrugating, notching, punching, and others. The majority of jobbing work can be handled with simple dies. The "goose-neck" die illustrated is a relatively simple die for making channels and other special shapes which cannot be made with a straight male die. Special dies further increase the wide utility of Cincinnati Press Brakes.

Write for Catalog B-2 or consult our Engineering Department on your special problem.

THE CINCINNATI SHAPER CO.

CINCINNATI OHIO U.S.A.

SHAPERS · SHEARS · BRAKES

for spotting holes quickly and for precision lay-out work.

The precision parts of this set can be assembled to provide internal and external inspection gages for locating pin centers and bores. They can also be used efficiently as a means of transferring hole positions and for the accurate reaming of holes. Perforating fixtures for metal and plastic materials can also be made by assembling parts from this set. 60

Air Gaging System

The Federal Products Corporation, 1144 Eddy St., Providence 1, R. I., has announced a new system of air gaging for which this company is exclusive sales agent. The "Metricator" equipment for this system of dimensional gaging by air is manufactured by Metricator Laboratories, Inc., Ann Arbor, Mich. As shown in the illustration, the equipment consists of a graduated column, a gaging head, and a manometer tube built into the water column which indicates variations in the air pressure. Air pressure from the regular plant supply line reduced to approximately 1 pound serves to operate the gage.

This system is designed for an amplification of 4000 to 1, which permits measurements to within 0.000025 inch to be easily read on the scale, one ten-thousandth inch being represented by a space of approximately 1/2 inch on the scale. Practically any inside dimension down to a diameter of 1/8 inch, and any outside dimension down to a diameter of 1/4 inch, as well as other dimensions of depth, width, etc., can be gaged singly or together. Precise gaging of diametral pitch, taper, bellmouth, barrel shape, and out-of-roundness can be accomplished in one operation. Stepped holes or holes having several diameters can have the different dimensions measured simultaneously by a composite gaging member.

By building a reduced size measuring orifice, holes as small as 0.156 inch in diameter and shoulders as narrow as 0.0937 inch can be precisely measured. Slots and grooves ranging from 0.0937 inch in width up can also be gaged. 61

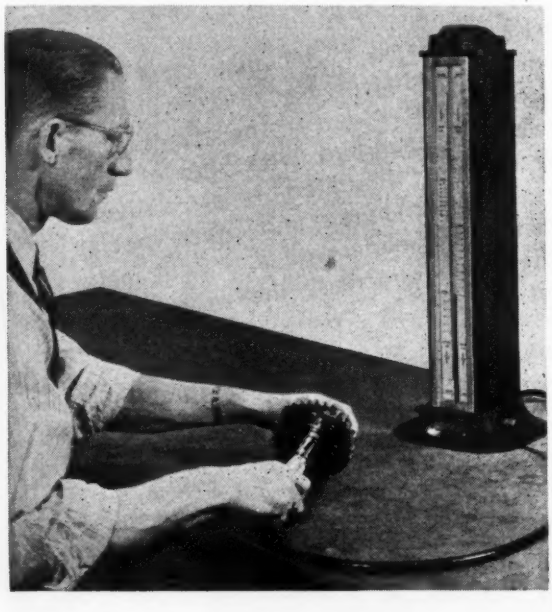
Kent-Owens Automatic Bar-Stock Machine

A machine designed to automatically mill and cut off parts from bar stock at a high production rate has been brought out by the Kent-Owens Machine Co., Toledo 10, Ohio. Two or more machines of this new design can be attended by one operator, whose only duty is to insert new bars. This machine is especially adapted for use in the manufacture of hinge parts, pole pieces, turbine blades, molding, hardware, etc. The machine shown in the illustration, for example, is set up for milling turbine blades from crescent-shaped bar stock, which is automatically fed against an end-stop by a torque motor and then clamped hydraulically. For this work, the head is equipped with three cutter-spindles, the two lower spindles having cutters for form-milling the blade, while the upper spindle carries a saw which cuts off the finished blade to the required length.

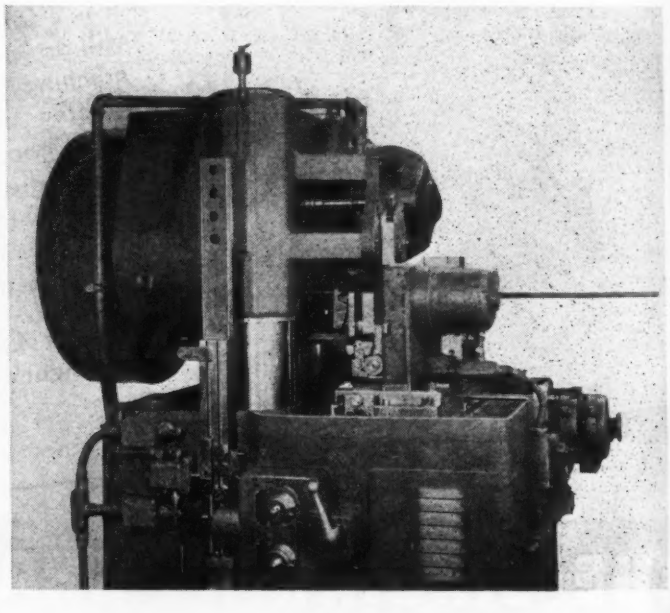
A fixture and clamping jaws can be provided to accommodate bar stock of various cross-sectional shapes. The head can be furnished with a single spindle for simple cutting-off operations or with a number of spindles for milling and cutting off as in the example described. 62

Spring-Loaded Live Center

A spring-loaded live center of new design, which is claimed to provide as rigid support as a dead center and to be equally accurate with respect to concentricity, is being manufactured by the General Allied Metals Co., 3835 Wilshire Blvd., Los Angeles 5, Calif. This center automatically adjusts itself to support the work. A heavy-duty ball bearing, two heavy-duty roller bearings, and a heavy-duty spring have been combined in this center to insure longer service. 63

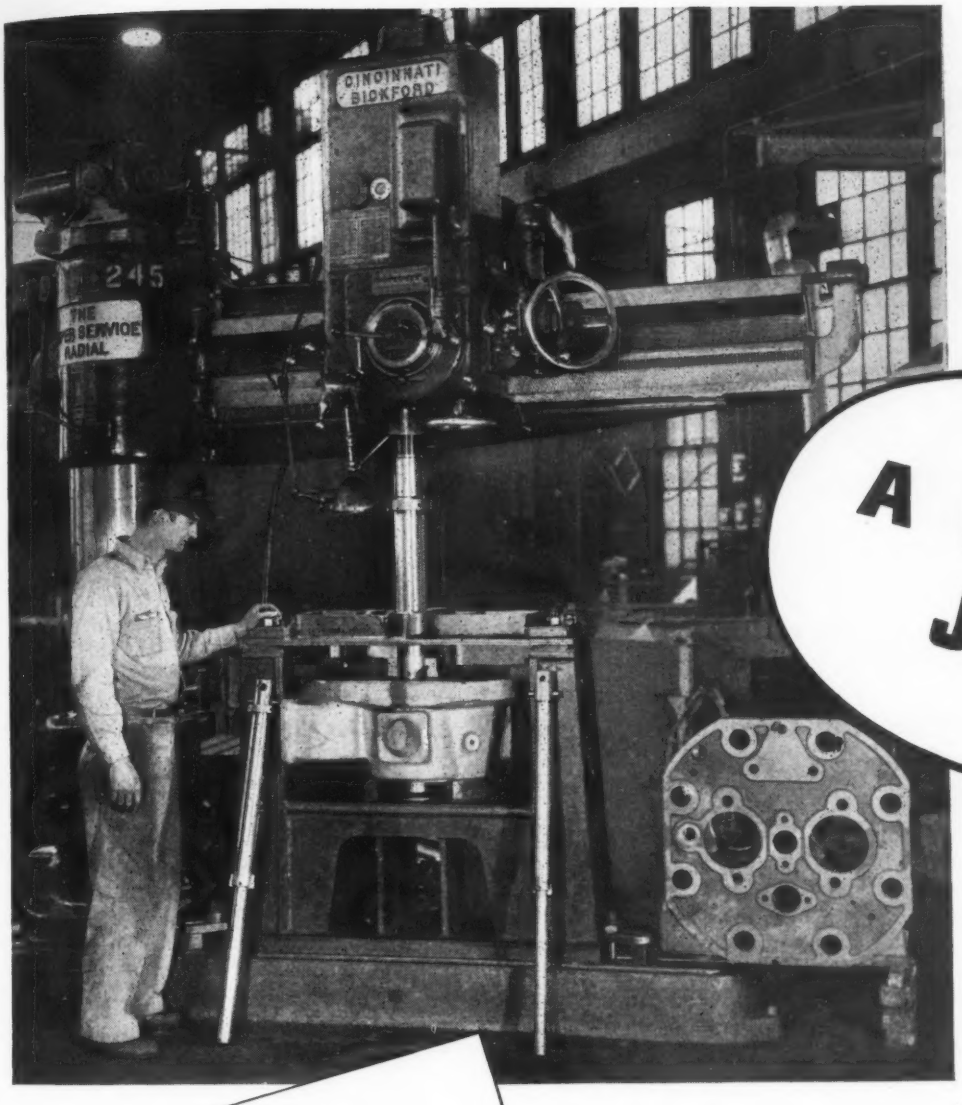


Federal Metricator System Air Gaging Equipment

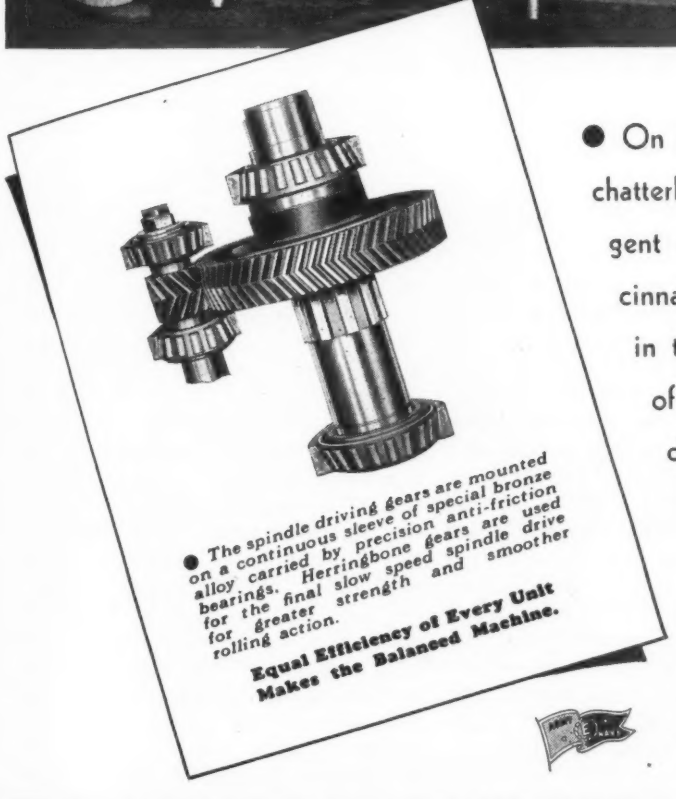


Kent-Owens Automatic Bar-stock Milling and Cutting-off Machine

To obtain additional information on equipment described on this page, see lower part of page 214.



A FUSSY JOB.



● The spindle driving gears are mounted on a continuous sleeve of special bronze alloy carried by precision anti-friction bearings. Herringbone gears are used for the final slow speed spindle drive for greater strength and smoother rolling action.

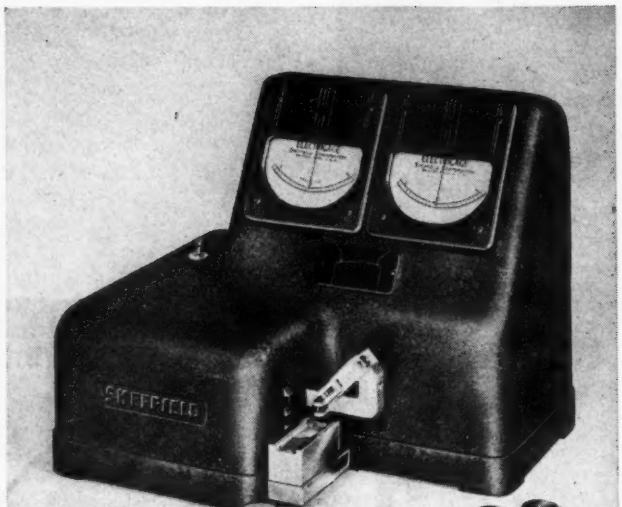
Equal Efficiency of Every Unit Makes the Balanced Machine.

● On these boring and drilling operations a smooth chatterless flow of power is necessary. The intelligent use of good tools and fixtures on this Cincinnati Bickford Super Service Radial—at work in the shops of The Fulton Iron Works Company of St. Louis—is another example of the productive and profitable performance of Cincinnati Bickford Radial Drills.

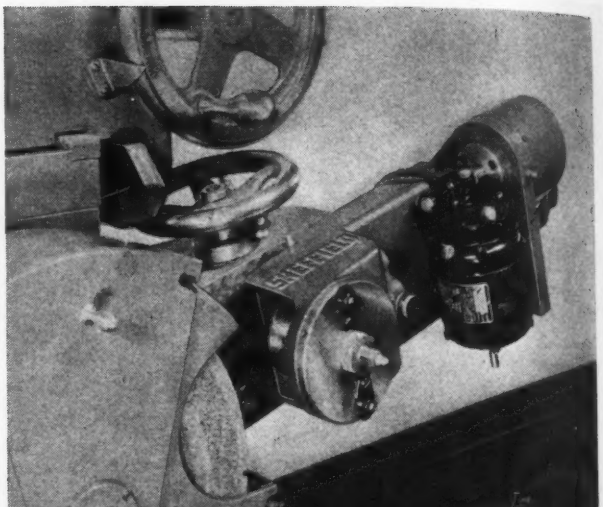
Write for Bulletin R-24-A

RADIAL AND UPRIGHT SUPER SERVICE DRILLING MACHINES

THE CINCINNATI BICKFORD TOOL CO. **Cincinnati 9, Ohio U.S.A.**



"Electrigage" Comparator for Checking Contour of Barrel-shaped Rollers



Sheffield Crush Dressing Device Applied to Thread Grinding Wheel

Comparator for Checking Contour of Barrel-Shaped Bearing Rollers

A comparator with "Electrigage" heads has been developed by the Sheffield Corporation, Dayton 1, Ohio, for checking barrel-shaped bearing rollers for correctness of contour. This comparator checks the contour only, and makes no direct check on any diameter. The bearing to be checked slides into the gaging position on two rails, coming to rest against the fixed center arm and lower roller backstop. The upper roller is spring-loaded to exert enough pressure on the bearing to keep it in the gaging position while being rotated for the complete contour checking operation.

The upper and lower arms do the gaging, while the middle arm is fixed and serves to position the bearing roller. The gaging fingers move reed mechanisms which, in turn, actuate the "Electrigage" heads. The middle arm is adjustable for various contours. Tungsten-carbide inserts are used on all three arms to insure longer life.—64

Motor-Driven Crush Dressing Device for Thread Grinding Wheel

The Sheffield Corporation, Dayton 1, Ohio, has developed a motor-driven crush dressing device to be used on the Model B Thompson surface grinder. This device is mounted on the wheel-head slide. A 1/3-H.P. gear-head motor is directly coupled to the grinding wheel spindle at the rear of the housing for driving the wheel at crushing speed through an overrunning clutch, which is thrown out of engagement when the machine is used for grinding threads. With this arrangement, the grinding wheel, driven at reduced speed, revolves the crusher roll when crush dressing. The crushing device is so located that the axes of both the crusher and the grinding wheel spindles are parallel within extremely accurate limits. With the crushing device mounted on the wheel-head slide, the crusher roll will not interfere with the work or be subjected to the abrasive action of the coolant, which is charged with wheel grit and metal particles.

An outstanding feature of this device is the method of feeding the crusher into the wheel by means of an electric motor, which turns the micrometer in-feed screw at a constant rate. This crusher dressing device is available in two styles —Model B which is semi-automatic and has a feed dial indicator preset for the desired depth of automatic in-feed of the crusher roll; and Model A which is arranged for the operator to control the device by depressing a push-button and releasing the pressure when the feed indicator shows that the desired depth has been reached. —65

"Toolface" Hard-Surfacing Welding Rod

A new welding rod developed for use in making, salvaging, and altering cutting tools, and for hard-surfacing operations where extreme hardness and resistance to shock and corrosion are required, has been brought out by the American Manganese Steel Division of the American Brake Shoe Co., Chicago Heights, Ill. This tough, superhard alloy tool-steel welding rod is composed of high-carbon, high-chromium, high-molybdenum tungsten and vanadium. This composition provides a material commonly known as high-speed steel. Its welded deposits have a Brinell hardness of 575 to 675.

The "Toolface" welding rod is especially adapted for the production of composite cutting tools, including those used on lathes, shapers, milling heads, etc. Its ready weldability expedites the depositing of cutting edges or lands on mild steel bases or shanks. The high degree of hardness of this hard-surfacing material and the ease with which it can be applied and dressed to a cutting edge are advantages claimed to result in a reduction in toolmaking costs.—66

To obtain additional information on equipment described on this page, see lower part of page 214.

Steinle Centerless Thread Generator

The Steinle centerless thread generator, used extensively by precision manufacturers in England for the last three years, is now being introduced in this country by the Steinle Machine Co., 63 Allyn St., Hartford 3, Conn. This machine is designed for the rolling of threads on parts made from high-tensile alloy steels, stainless and soft steels, and non-ferrous metals. It is adapted for use in aircraft, automotive, and other industries requiring precision threading equipment for all classes of threads, including right- and left-hand. It can be used to roll shoulder threads and also for straightening shafts and for knurling.

Threads from 28 to 9 threads per inch can be rolled on high-tensile alloy-steel pieces having diameters ranging from 1/8 inch to 1 3/16 inches, and lengths up to 2 1/4 inches. Larger diameters can be rolled in soft steel and non-ferrous metal. Hollow parts within certain limitations can also be effectively rolled. Production varies from 1 1/2 seconds per piece upward.

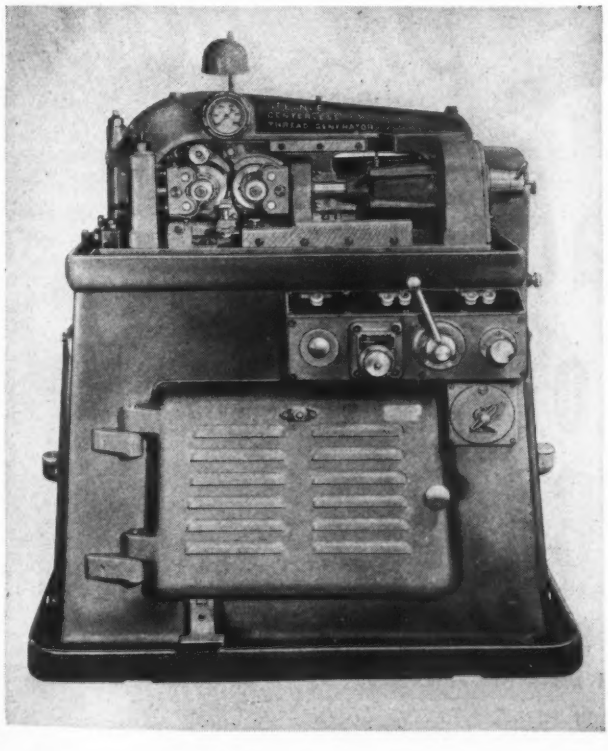
The piece to be threaded is carried on the work-rest with its center line slightly below the centers of the two circular thread-forming rolls. The hardened-steel rolls have ground grooves which are negative reproductions of the thread to be rolled; the rolls for a 3/4-inch thread may be 4 1/2 inches in diameter. One roll revolves about a stationary axis, while the other roll, known as the "sizing roll," is mounted on a heavy dovetail slide. The thread on the work is rolled to size between the rolls by feeding the sizing roll inward to a predetermined point, at which it is automatically released by the electric sizing and tripping device and returned to its starting position to allow removal of the threaded piece. There is no axial movement of the work during the generating cycle, the blank merely revolving in contact with the threaded rolls.

The panel at the right-hand side of the machine has a hand-lever which controls the cycle of movements and the roll slide. Start and stop buttons are provided for the spindle drive, hydraulic pump, and coolant motors. A slide trip push-button is also furnished for instantaneous return of the roll slide. Coupled with these controls is a foot-lever, which stops all motors, releases the hydraulic pressure, and permits the roll slide to return to its rear position. Variable control valves are provided for the rate of roll-slide advance and work pressure, both of which operate independently. The hydraulic work pressure is registered on the gage shown in the top bracket. The machine weighs about 2900 pounds, and requires a floor space of 47 by 37 3/4 inches. 67

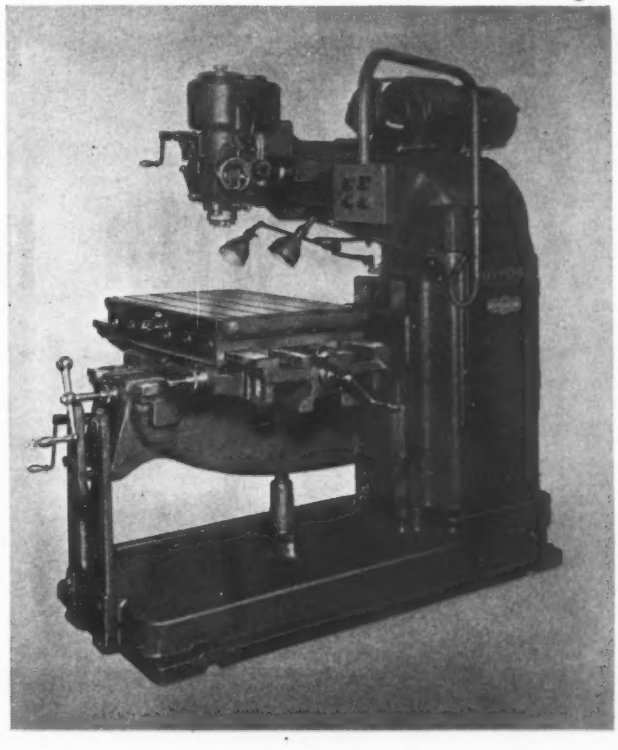
Reed-Prentice Vertical Tool-Room Milling Machine

A new heavy-duty knee type vertical milling machine designed for tool-room and die-sinking work has just been announced by the Reed-Prentice Corporation, Worcester 4, Mass. This machine, designated No. 22V, has a variable-speed drive to the spindle and electronic drive for the table feeds. The spindle head has a tilting arrangement which provides for milling at all angles within 45 degrees front and back and within 30 degrees left and right of the vertical position. The head and transmission are mounted on a sliding ram in order to increase the operating range.

The spindle is driven by a 3-



Steinle Centerless Thread Generator Designed to Roll Precision Threads



Reed-Prentice Tool-room Milling Machine with Tilting Spindle Head

To obtain additional information on equipment described on this page, see lower part of page 214.

For quick future Action:
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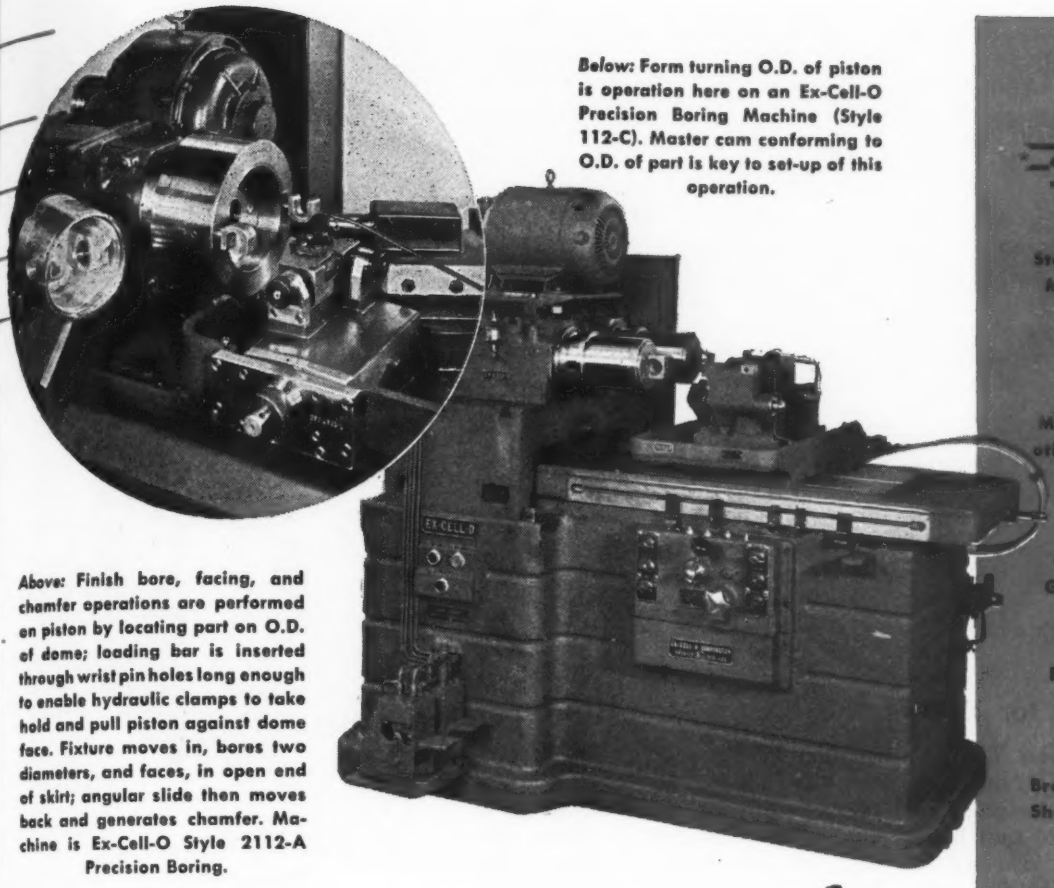

Below: Form turning O.D. of piston is operation here on an Ex-Cell-O Precision Boring Machine (Style 112-C). Master cam conforming to O.D. of part is key to set-up of this operation.

Above: Finish bore, facing, and chamfer operations are performed on piston by locating part on O.D. of dome; loading bar is inserted through wrist pin holes long enough to enable hydraulic clamps to take hold and pull piston against dome face. Fixture moves in, bores two diameters, and faces, in open end of skirt; angular slide then moves back and generates chamfer. Machine is Ex-Cell-O Style 2112-A Precision Boring.

reconversion list

Already is indicated the nature of things to come, as far as tomorrow's production costs are concerned. One main source for lower costs will be machine tools that offer more efficient methods for production, through progressive stations and multiple operations. In developing standard and special machine tools that perform a variety of close-limit operations, Ex-Cell-O has had unique experience that eminently qualifies it to meet the production problems facing the major industries of this country. Write to Ex-Cell-O Corporation, Detroit 6, Michigan, today.

Where increased production, high accuracy, and greater economy through multiple operations are required . . . See Ex-Cell-O First!

Right: If you do not now receive Ex-Cell-O TOOL TIPS, devoted to precision and speed in production, send your name, company, address and position to Ex-Cell-O Corporation, 1200 Oakman Boulevard, Detroit 6, Michigan.

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Standard and Special Multiple Way-Type Precision Boring Machines

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Precision Thread Grinding Machines

•

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•

Broaches and Broach Sharpening Machines

•

Continental Cutting Tools

•

Tool Grinders

•

Hydraulic Power Units

•

Grinding Spindles

•

Drill Jig Bushings

•

Fuel Injection Equipment

•

R. R. Pins and Bushings

•

Pure-Pak Paper Milk Bottle Machines

•

Aircraft and Miscellaneous Production Parts

65—70

DETROIT 6, MICH.

H.P. 1800-R.P.M. alternating-current motor. Although this is a constant-speed motor, infinitely variable spindle speeds are obtainable between approximately 90 and 2200 R.P.M. by means of a Reeves drive. The push-button remote control drive gives the operator finger-tip control over the spindle speed and permits speed adjustments to be made while the cutter is in action. A spindle speed indicator, graduated in revolutions per minute, is mounted on the variable-speed transmission unit.

An auxiliary high-speed drilling head, driven by a 1/2-H.P. alternating-current motor, provides spindle speeds ranging from 410 to 6450 R.P.M. The high-speed head can be installed without removing the standard head.

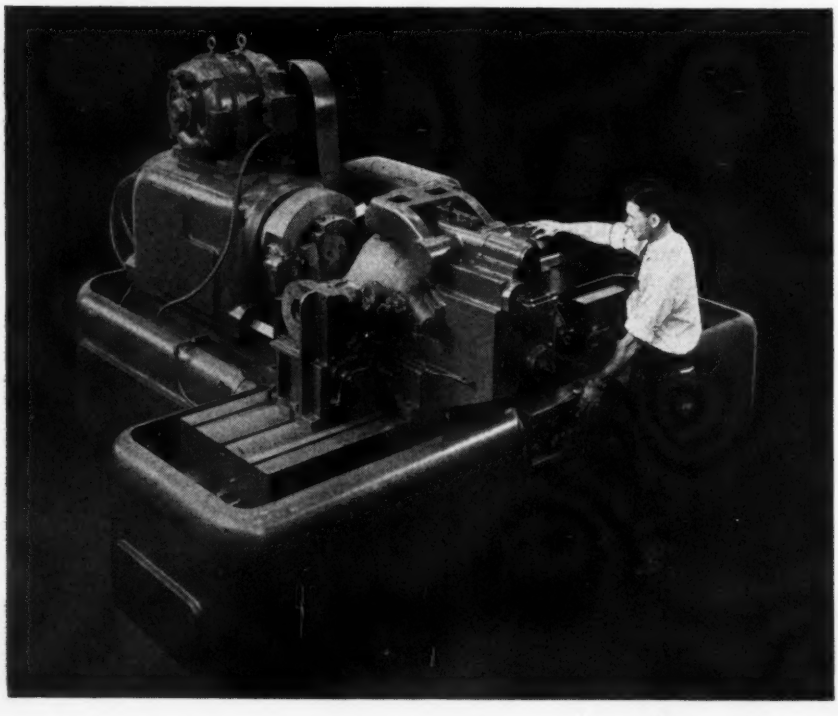
The table has a working surface of 32 by 22 inches, and is 4 inches thick. Vertical feed of the knee is hand-operated, and has a travel of 16 inches. Longitudinal and cross feeds have a range of 27 and 20 inches, respectively, and are power-driven by a variable-speed electronic unit, which provides a feed range of about 1/2 inch to 40 inches per minute, and is equipped for dynamic braking to obtain rapid deceleration.

The centralized push-button control station is mounted on a pendent arm having a 90-degree swing which can be adjusted to bring the control station within easy reach of the operator in any working position. The magnetic control panel and the electronic unit are mounted inside the machine column. The machine, with power feed, weighs 6750 pounds. 68

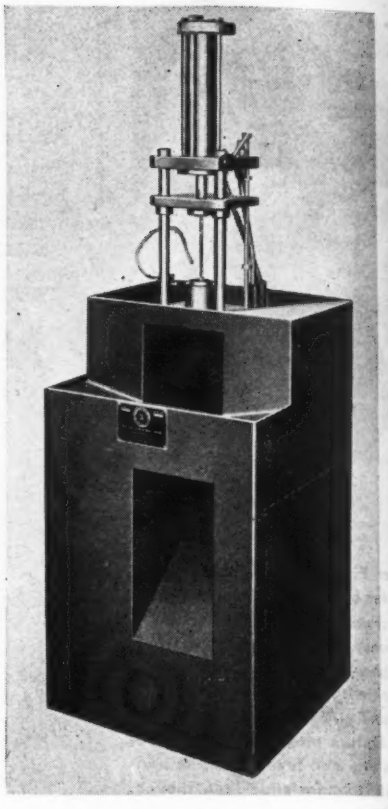
Cross Automatic for Boring and Facing Axle Housings

The Cross Co., Detroit 7, Mich., has brought out a special universal automatic machine designed to simultaneously bore and face banjo axle housings for a variety of trucks and tractors. The full automatic cycle of this machine can be arranged to bore and face the bowl flanges and the inner lugs on both front and rear axle housings.

This machine has a power-operated gaging mechanism for use in automatically locating the work prior to power clamping. This new feature eliminates the necessity for manual location, surface-plate lay-out, and subsequent gaging of the lay-out required by methods formerly employed. A full automatic operating cycle of this special boring machine is controlled from a centralized push-button station designed to facilitate economical production of accurate work. 69



Banjo Axle Housing Boring and Facing Machine Built by the Cross Co.



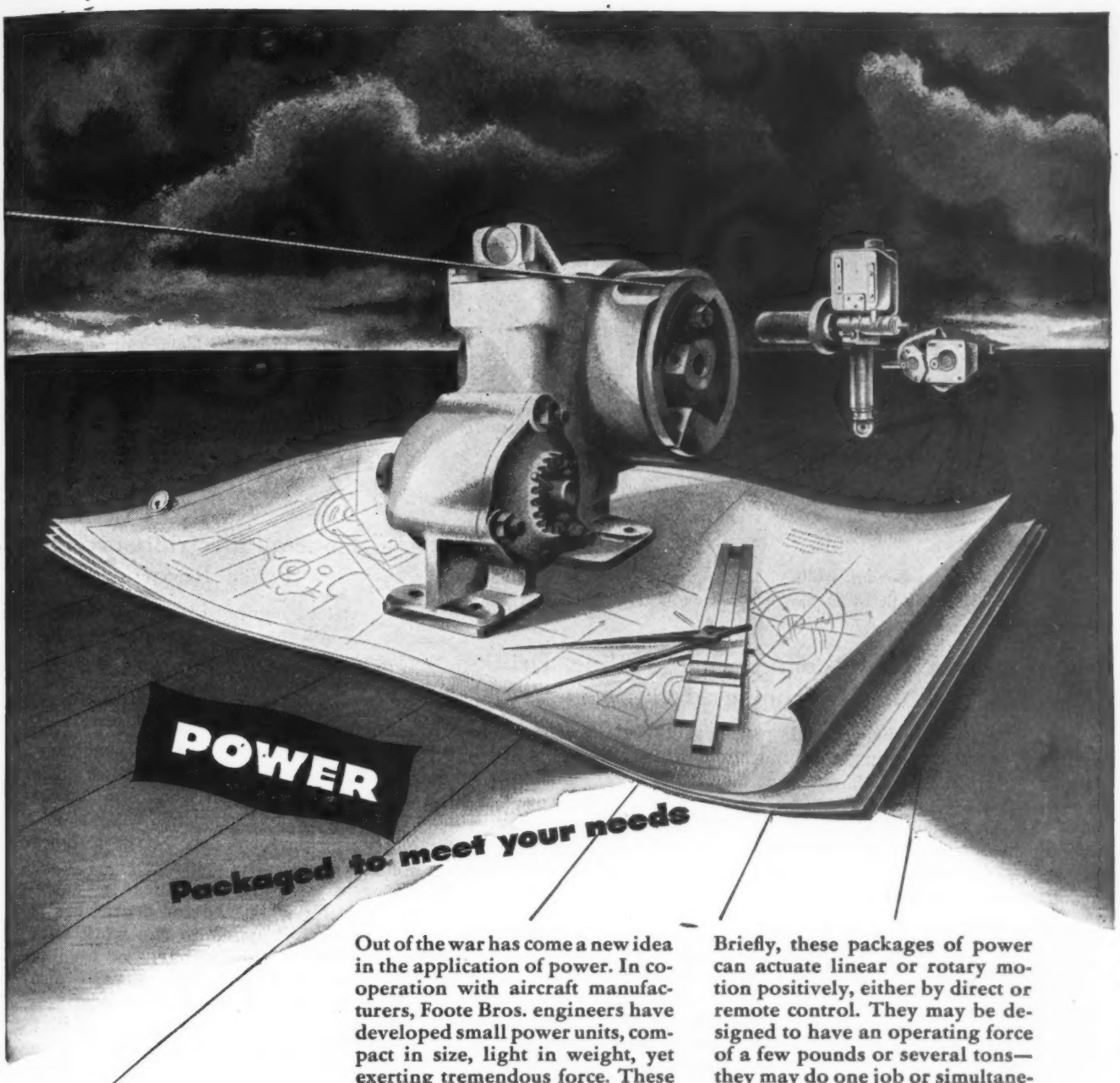
Zagar Machine for Broaching Small Parts

Zagar Vertical Broaching Machine

A 10-inch vertical broaching machine designed especially for use in broaching small parts has been brought out by Zagar Tool, Inc., 23880 Lakeland Blvd., Cleveland 17, Ohio. This machine has three guide bars, arranged as shown in the illustration, and is built to positively push the broach straight through the work without deflection in the machine column. In operation, the broach is pushed by a cone-shaped cup located in the top adapter plate, which fits the 45-degree angle conical end ground on the pushing head of the broach.

After the broach has been pushed through the work, it is carried back to its original position for repetition of the broaching cycle. The broach is operated by a 1-H.P. motor, and will exert a pressure of 1 ton at a speed of 25 feet per minute. Two speeds are available, and there is a fast return stroke. Standard equipment includes a built-in coolant tank and a Cuno oil filter. Production rates up to 200 pieces per hour are often obtained on this machine. 70

To obtain additional information on equipment described on this page, see lower part of page 214.



Out of the war has come a new idea in the application of power. In cooperation with aircraft manufacturers, Foote Bros. engineers have developed small power units, compact in size, light in weight, yet exerting tremendous force. These power units are designed for accessory drives and to open and close ventilators, trim stabilizers, operate wing flaps, and perform many other jobs that otherwise would have to be done manually.

Right now in development in the laboratories at Foote Bros. are other applications of these power units—applications on peacetime machines and equipment—that will mean more efficient operation—that will result in definite competitive advantages.

Briefly, these packages of power can actuate linear or rotary motion positively, either by direct or remote control. They may be designed to have an operating force of a few pounds or several tons—they may do one job or simultaneously perform many.

For the machines or equipment you are manufacturing or planning to manufacture, Foote Bros. power units may assure you greater operating efficiency, more compact design, lighter weight, or better engineering. They may simplify your design problems and even make a design practical that without them would be impractical.

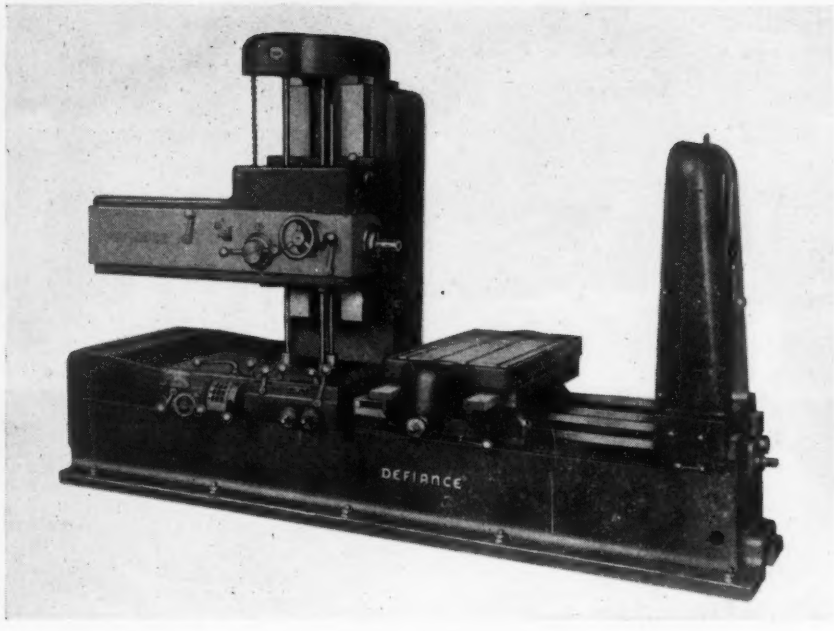
Foote Bros. engineers will gladly discuss the application of power units to your equipment.

A copy of this informative product engineering manual on "A-Q" gears will be sent to you on request.

FOOTE BROS. GEAR AND MACHINE CORPORATION, Dept. P, 5225 S. Western Blvd., Chicago 9, Ill.

FOOTE BROS.

Better Power Transmission Through Better Gears



Tool-room Boring, Milling, Drilling, and Tapping Machine Built by Defiance Machine Works, Inc.

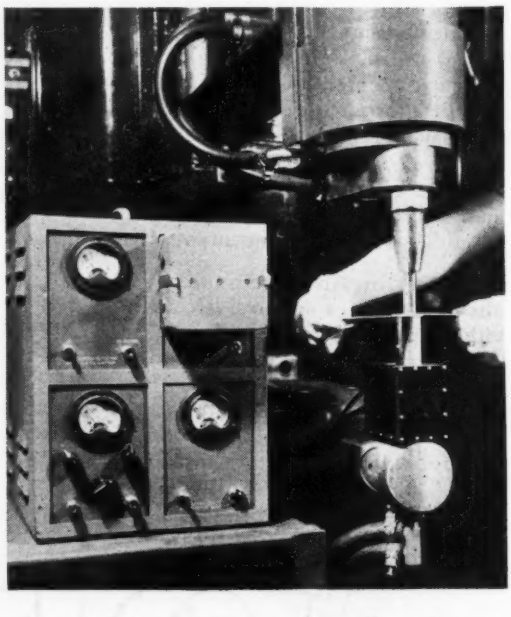
Defiance Tool-Room Boring, Milling, Drilling, and Tapping Machine

A new horizontal boring, milling, drilling, and tapping machine, known as Model No. 22, which is especially suited for tool-room work on small jigs and dies, has been announced by the Defiance Machine Works, Inc., Defiance, Ohio. This machine has been designed to meet the requirements of machine tool users wherever intensive production on precision work is required. Positive, infinitely variable spindle speeds from 25 to 1600 R.P.M. in either direction are directly obtainable on this machine. A direct-reading indicator, covering this complete range of spindle speeds, and a direct-reading feed chart are provided. The machine is equipped with a brake for stopping the spindle. There are eighteen feeds in geometrical progression, ranging from 0.002 to 0.125 inch per revolution of the spindle. Five of the available feeds are standard tapping leads.

In a recess cast on the under side of the head is mounted a fluorescent lamp, and in the front of the head and to one side of the spindle there is a retractable light for use in inspecting the tool and work. Directly above the spindle is a 3-inch overarm which can be pulled out from its housing. Provision is made for attaching a high-speed milling or drilling unit for vertical work.

Accessories include precision thread-cutting attachment for English or metric threads; coolant equipment; dial indicators and end measures for head and table movements; verniers for head and table movements; 30- by 30-inch swivel table with power feed; 24- by 24-inch auxiliary swivel table with power feed; and 24- by 24-inch auxiliary swivel table with hand feed.

Specifications include fast travel to all units at rate of 95 inches per minute; vertical adjustment of spindle head, 24 inches; table size, 24 by 36 inches; cross travel of table with automatic stop, 36 inches; longitudial adjustment of saddle on bed, 34 inches; distance between spindle sleeve and bar support, 60 inches; maximum distance from center of spindle to top of table, 24 inches. The machine requires a space of 105 by 155 inches, and weighs 19,800 pounds. 71



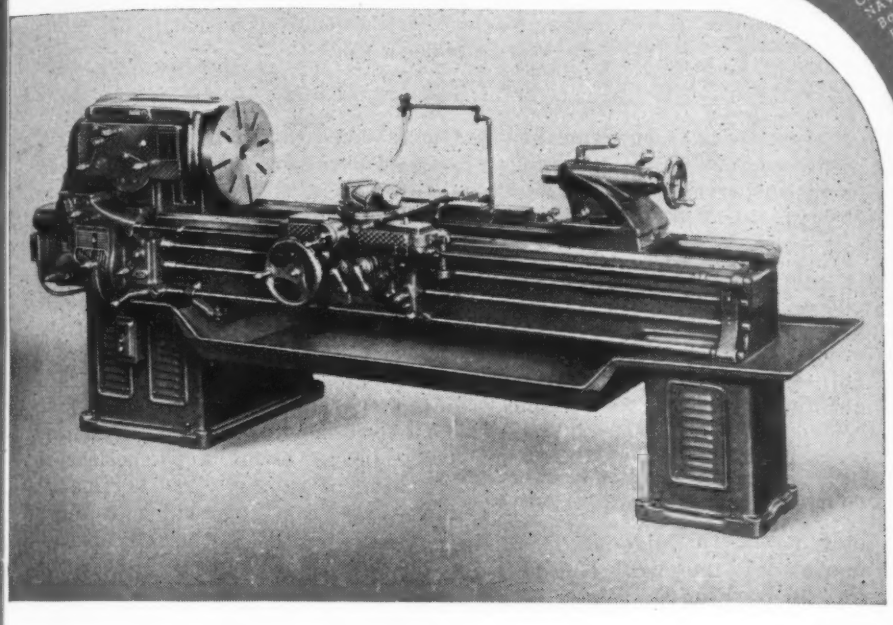
Typical Set-up of Current-force Recorder on Resistance Welder

General Electric Current-Force Recorder

New equipment for recording the electric current and force employed in the application of resistance welding electrodes has been developed by the Special Products Division of the General Electric Co., Schenectady 5, Schenectady, N. Y., which is especially useful in welding research work and for the periodic checking of welding machine performance. It is designed to assist users of energy-storage type welding machines in determining when the force pressure is properly applied to the work with respect to the discharge of welding current. The recorder also makes it possible for resistance welding machine users to comply with Navy Specifications, Navaer PW-6A, Bureau of Aeronautics, Specifications for the Spot Welding of Aluminum Alloy for Class A Spot-Welding.

This recorder is compact, portable, and easy to use. It consists of an amplifier-oscillograph unit and a special electrode-holder. The amplifier - oscillograph unit simultaneously records a timing wave, rapidly charging electrode force, and the electrode current of the welding machine while the weld is being made. The record produced also indicates the squeeze time, the duration and magnitude of the welding current, the rate of rise of forge pressure,

To obtain additional information on equipment described on this page, see lower part of page 214.



THE SIDNEY TOOL ROOM LATHE

A sturdy lathe designed and built to give utmost in precision work and flexibility to meet the varying demands of tool room operation.

Forty-eight changes of feeds from .0027 to .172 and 49 changes of threads from 1½ to 92, all easily accessible to operator from his normal working position, make it adaptable to an exceptionally wide range of work.

An exclusive Sidney feature, the continuous tooth herringbone geared head assures the required accuracy and the smooth finish desired on tool room work.

Full descriptive bulletin upon request.

The SIDNEY MACHINE TOOL Company

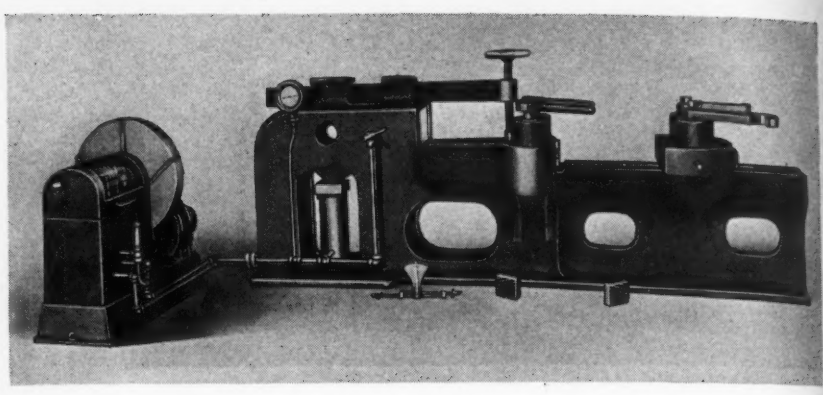
Builders of Precision Machinery

SIDNEY ESTABLISHED 1904 OHIO

and the "hold" time. The welding current and 60-cycle timing wave are indicated simultaneously on the 3 1/2-inch paper record. 72

Walter Stock Adjusting Machine

The Walter stock adjusting machine here illustrated is being built by the Watson-Stillman Co., Roselle, N. J., for use in lengthening, straightening, or shortening locomotive parts. Some thirty-six repair jobs on various parts of running and valve-motion gear of locomotives can be handled quickly and accurately on this machine, thus making it possible to get equipment back in service with a minimum of lost time.



Walter Stock Adjusting Machine for Locomotive Parts, Built by Watson-Stillman Co.

This stock adjusting machine is simply but ruggedly built of steel throughout. It consists of a frame, two links, a ram, a filler block, a sliding block, four eccentric gripping cams, a clamping bar with wheel and screw, a wedge block, and two binding links. Three types of power equipment can be furnished—hand pump, accumulator, or motor-driven pump. The capacity of the hydraulic cylinder of this machine is 50 tons when equipped with the motor-driven pump. The machine requires a floor space of 3 1/2 by 12 feet. A space 1 1/2 by 3 1/2 feet is required for the power unit. The machine weighs 11,250 pounds. 73

Vaill Tube-End Forming Machine

An automatically operated, double-action, hydraulic press of compact powerful design for use in beading, flaring, flanging, sinking, expanding, and double-lap flaring and flanging of all sizes of tubing from 1/4 inch to 3 inches in diameter has been introduced on the market by the Vaill Engineering Co., 70 N. Elm St., Waterbury 89, Conn.

This versatile machine, designated No. 7, is double-acting in that there is a vertical-traverse cross-head that can be employed to exert pressures up to 50,000 pounds through a 2-inch stroke, and a horizontal-traverse ram that can exert pressures up to 30,000 pounds through a 6-inch stroke. It is automatic in that pressing a push-button causes the machine to complete one cycle in 2 to 12 seconds.

During the operating cycle, the vertical-traverse cross-head first moves down to close dies or clamping blocks about a pre-positioned section of tubing. The horizontal-traverse ram, on which forming punches or dies are usually mounted, then moves in to process the tube end, and withdraws. At this time, the vertical-traverse cross-head rises to permit the removal of the formed tube. Each phase of the operating cycle progresses auto-

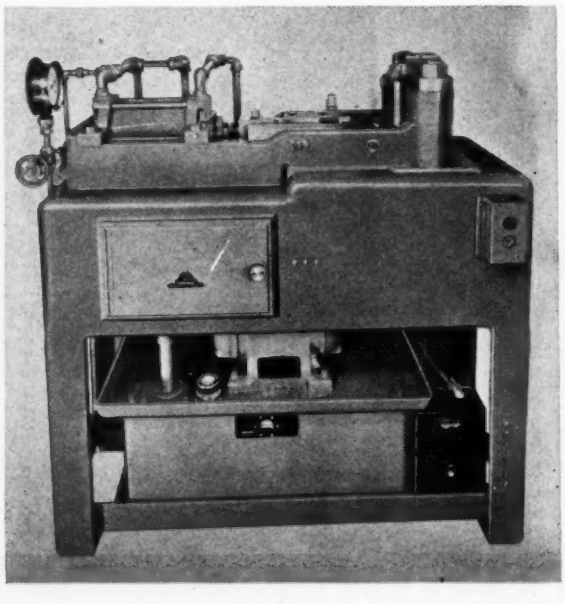


Fig. 1. Vaill Automatic Double-action Tube-end Forming Machine

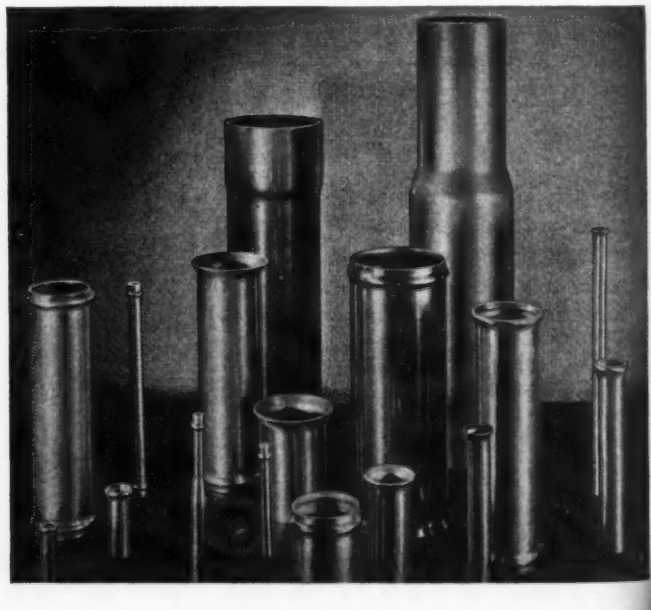
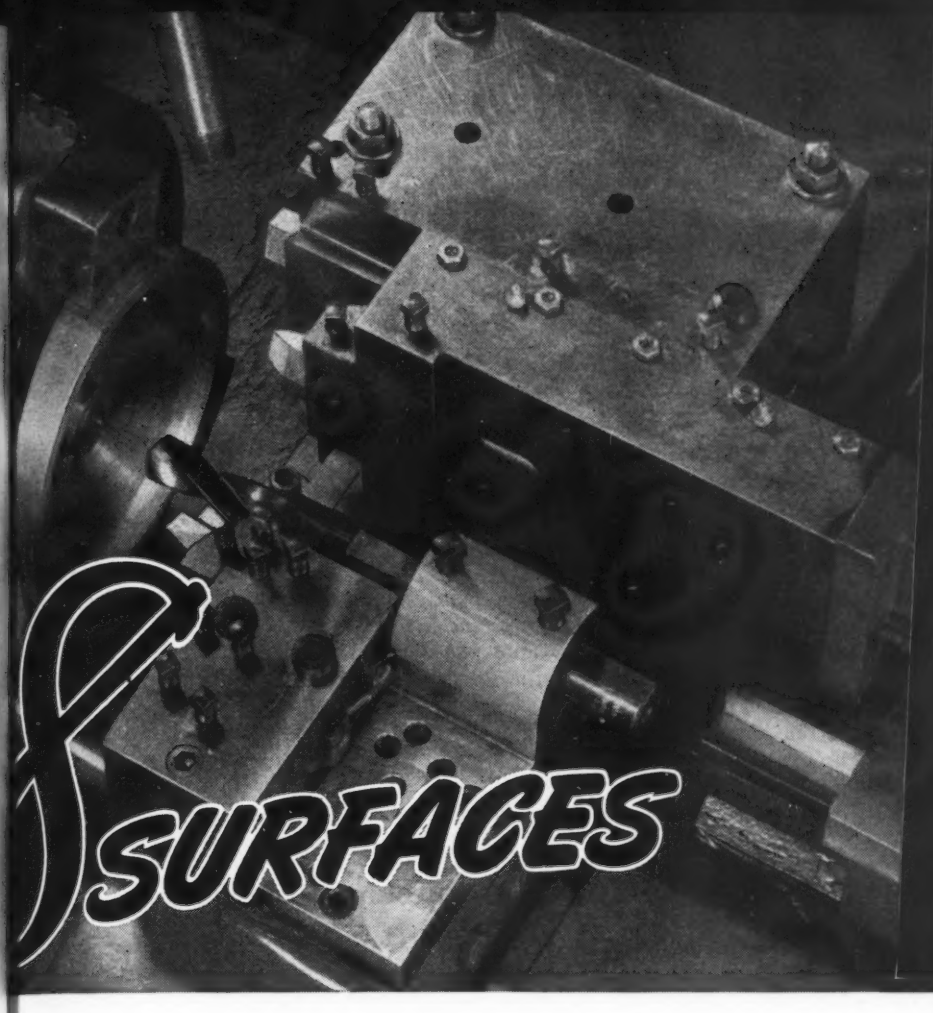
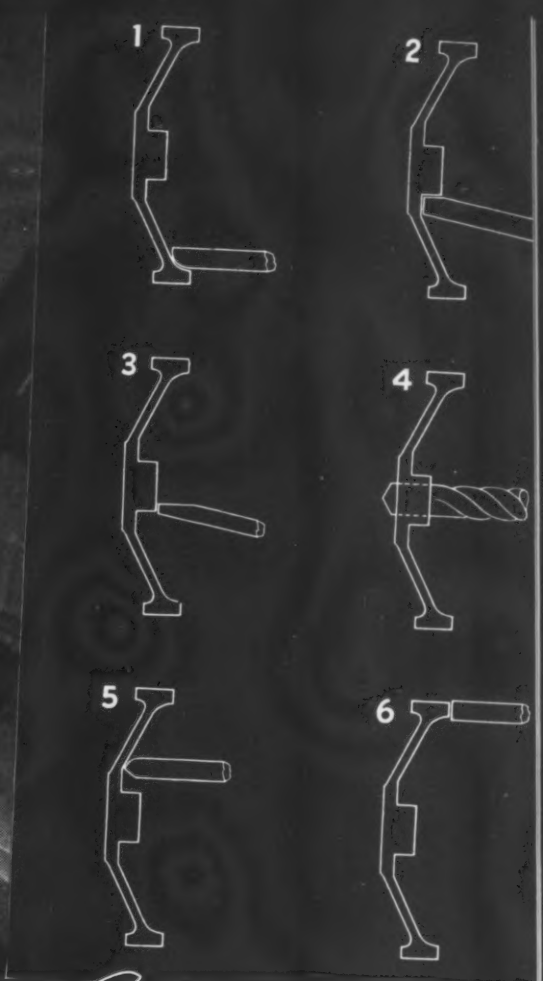


Fig. 2. Examples of Tube-end Forming Performed on Machine Shown in Fig. 1

To obtain additional information on equipment described on this page, see lower part of page 214





. . . MACHINED BY 6 TOOLS

. . . IN *ONE* OPERATION

WITH the Gisholt Hydraulic Automatic Lathe you merely touch a simple lever and a whole machining cycle is carried out automatically.

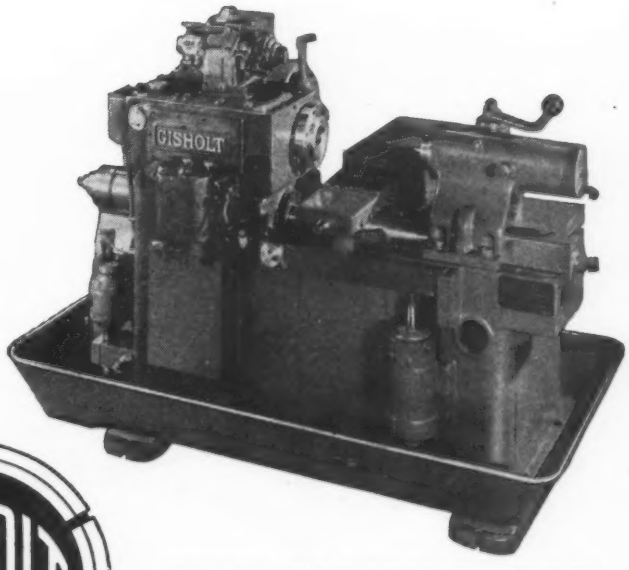
Take the alloy steel gear pictured above. Here's a piece that calls for turning, drilling, boring, forming, straight and taper facing on hub, rim and web. Yet, with the Gisholt Hydraulic, the time for the entire job is merely the time of the longest individual cut.

Thus, identical parts can be machined in rapid succession, with the greatest accuracy—and nothing for the operator to do but load and remove the work.

This kind of low-cost, automatic production can help you now, and for years to come. Ask for complete information.

GISHOLT MACHINE COMPANY
1209 East Washington Ave. • Madison 3, Wisconsin

Look Ahead . . . Keep Ahead . . . with Gisholt Improvements in Metal Turning



GISHOLT HYDRAULIC AUTOMATIC LATHES provide high speed multiple cutting with extreme accuracy. Adaptable to a wide variety of between-centers and chucking work, they can out-produce triple their number in manually-operated machines.

GISHOLT

TURRET LATHES
AUTOMATIC LATHES
BALANCING MACHINES
SPECIAL MACHINES

matically without the attention of the operator. Depressing the stop-button at any time during the operating cycle causes the machine to reverse instantly and open the dies.

The press occupies a floor space of 50 inches by 30 inches, and has a height of 54 inches and a weight of 2400 pounds. 74

Boyar-Schultz Screw-Machine Tools

A new larger size screw-machine tool designated Model 3RT, which is designed for making quick accurate set-ups for precision machining under exacting conditions on both automatic and hand screw machines, has been added to the line made by the Boyar-Schultz Corporation, Walnut St. at Hoyne, Chicago 12, Ill. This tool is available with a 1 1/4- or 1 1/2-inch diameter shank in the design shown in Fig. 1. It has a turning capacity ranging from 5/16 inch to 1 1/4 inches in diameter, and will take cuts up to 3 1/4 inches in length.

Another new screw-machine tool, known as Model 000RT has also been added to this company's line. This tool, shown to the left in Fig. 2, is designed for turning extra small parts. Parts as small as 0.075 inch in diameter can be turned with the roller equipment, which can be replaced by carbide blocks for turning parts as small as 0.020 inch. The bits used in this tool can be removed for grinding and returned to the same precise setting with a minimum of adjustment.

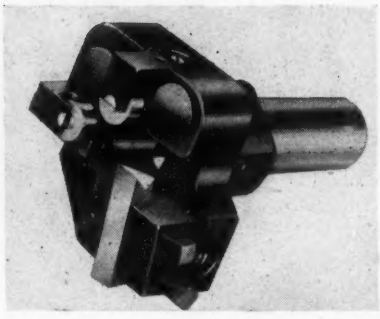


Fig. 1. Boyar-Schultz Model 3RT Screw-machine Tool

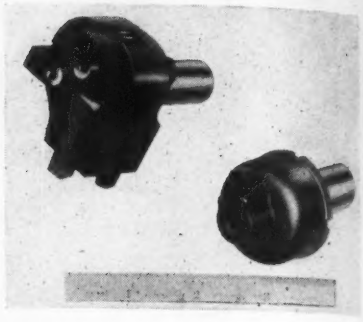


Fig. 2. Screw-machine Tool and Floating Tool-holder

The Model 000D floating tool-holder, shown in the lower right-hand corner of Fig. 2, is still another new product of the Boyar-Schultz Corporation. This floating tool-holder, intended for small precision work, will handle parts up to 1/4 inch in diameter by 9/16 inch in length. It has a feather-weight tool-head designed to assure fast accurate alignment for maximum accuracy in reaming, counterboring, and drilling. 75

Master Universal Checking Plate Fixtures

Master Industries, Inc., 709 E. 38th St., Indianapolis 5, Ind., have recently developed a universal checking plate equipped with bench centers, riser plates, angle-plates, and a vertical riser bar for holding work at any angle between centers. All these accessories are mounted on the accurately scraped back or rear side of the plate, and are furnished with the standard unit.

A 20-inch universal sine-bar unit is also furnished, making it possible to check angle and taper work between centers or in V-blocks with extreme accuracy. By the use of this sine bar, ring gages for checking taper plug work can, in most instances, be eliminated. Plates of various sizes can be furnished.

The bench centers, mounted on the vertical center bar as shown in Fig. 1, provide means for holding work at different angular positions

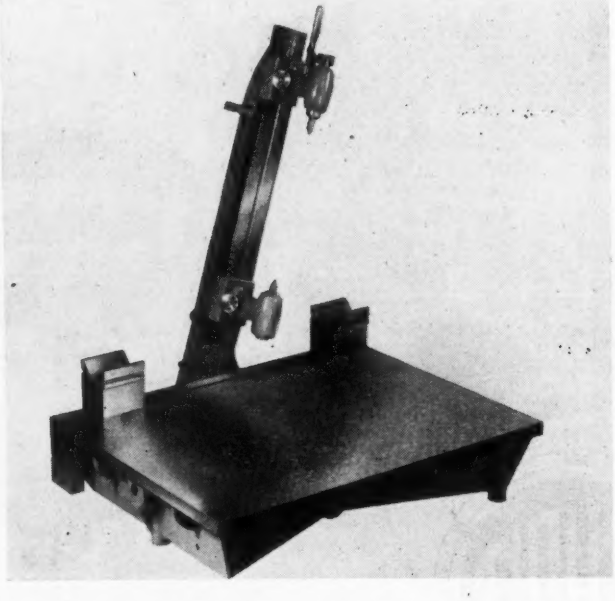


Fig. 1. Master Universal Checking Plate with Bench Centers

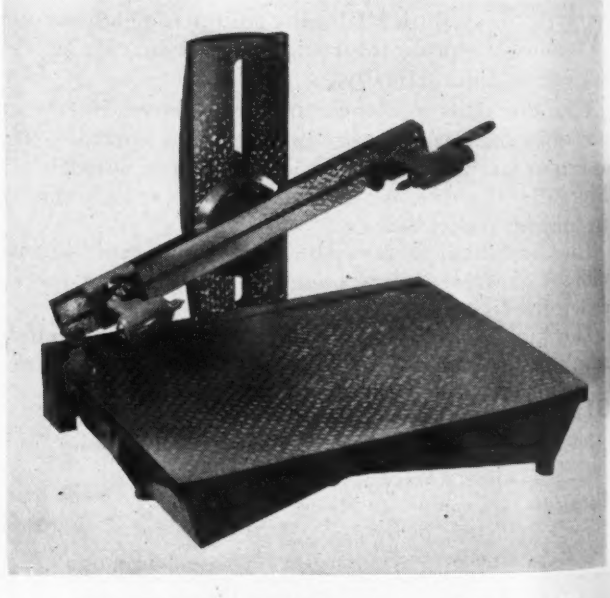


Fig. 2. Master Checking Plate with Universal Sine-bar Unit

To obtain additional information on equipment described on this page, see lower part of page 214.

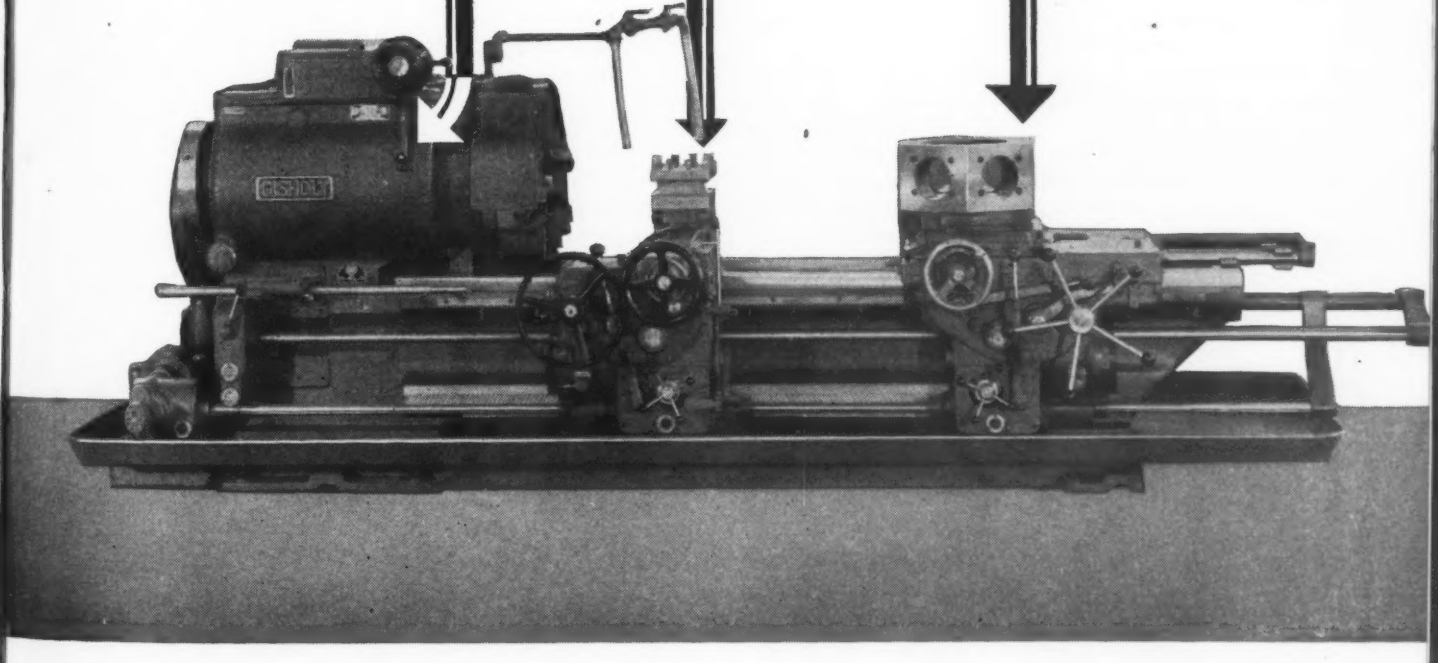
Adaptable . . .

Here's a Gisholt advantage that pays big dividends . . . the ability to handle a broader range of work when the need arises. Take, for example, the Gisholt 4L Saddle Type Turret Lathe. A big machine, to be sure, yet its flexibility and ease of operation enable it to handle smaller work too. Here are a few of the reasons why:

1 Hydraulic clutching and braking make it possible for the operator to start, reverse, or stop the spindle—as quickly and as effortlessly as on many smaller machines. One easy movement of one lever is all it takes. Response is instantaneous, smooth, positive.

2 Power rapid traverse for the side carriage is provided not only for longitudinal movement but also for in-and-out movement of the cross slide. Here's greater ease and speed for bringing tools quickly into cutting position.

3 This massive cross-feeding hexagon turret is more accurate—more adaptable with its 16 reversible feeds and automatic feed trips for both longitudinal and cross feeds. It can be locked rigidly on center for bar work—or chucking work with piloted tools.



Adaptability is a fact that applies to both Gisholt Saddle Type and Gisholt Ram Type Turret Lathes. Make the most of it. Explore the possibilities of each type to assure the most flexible and economical set-up for your own production. Ask for literature.

GISHOLT MACHINE COMPANY • 1209 *E. Washington Ave., Madison 3, Wis.*

Look Ahead...Keep Ahead...With Gisholt Improvements in Metal Turning

GISHOLT

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES • SPECIAL MACHINES

from vertical to 45 degrees in either direction. This equipment is especially adapted for inspecting work for step and shoulder length dimensions and concentricity. The universal sine-bar unit, shown in Fig. 2, is supported on a riser plate bolted over the key insert in the baseplate. The riser plate is square with the surface plate within 0.0001 inch per foot. The center distance between the sine rolls is 20 inches. The protractor reads to 45 degrees either side of the horizontal position. The maximum distance between centers is 15 inches, and the height of the centers from the bar is 4 inches. Vertical adjustment in the slotted riser plate is approximately 6 inches. ----76

"Magne-Blox" Made in Special Sizes and Shapes

The George Scherr Co., Inc., 199 Lafayette St., New York 12, N. Y., has just extended its line of "Magne-Blox," "V-Blox," laminated parallels, and angle-irons to include the manufacture of special sizes, shapes, and forms to suit individual specifications. The "Magne-Blox" of this new line can be so designed that work placed directly on the magnetic block can be held securely for grinding operations by simply turning on the current, without requiring the use of additional clamps.

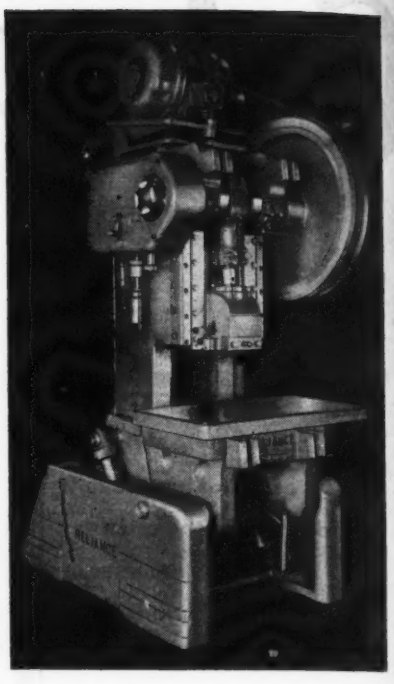
The laminations of the standard sizes of "Magne-Blox" can now be made to conform to the lamination spacings of any type of magnetic chuck. Various odd "V-Blox" made to special angles, and heavier parallels produced to individual specifications, are shown in the accompanying illustration. ----77

Westinghouse Electrodes

For speedy and economical welding in all positions, with alternating-current and direct-current reverse polarity, the Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa., has brought out a new electrode known as the "ACP." It is available in seven diameters from 3/32 to 5/16 inch. The new heavily coated electrode is recommended for work that is not easily positioned. It forms a light, porous slag which is easily removed by light brushing. Because of the high tensile strength and ductility of the welds made with this electrode, it is especially suited for heavy plate fabrication, shipyard work, pressure piping, pressure vessels, and general structural steel work. ----78

Inclinable Punch Press

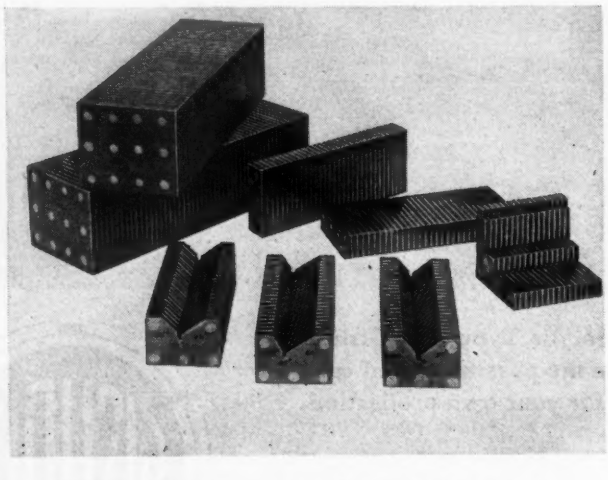
A 30- to 40-ton inclinable flywheel type punch press with hydraulically controlled clutch, braking and releasing at a pressure of 150 pounds per square inch, has just been introduced on the market by the Reliance Machine & Tool Corporation, 10 Van Cortlandt Ave. E., New York 58, N. Y. This machine uses standard hydraulic equipment, Timken bearings in the flywheel, and can be furnished with a hydraulic inclining device if desired. A pressure of 18 pounds on the foot-pedal is required to trip the press, which can be set for single- or continuous-cycle operation. The press without the motor weighs about 6650 pounds. ----79



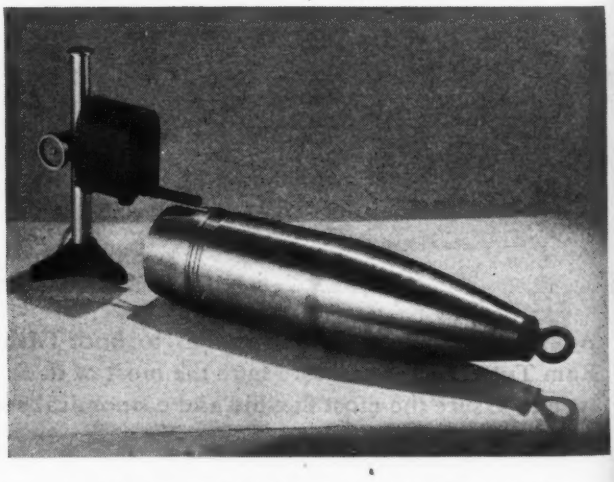
Reliance Punch Press

Rough-Finish Measuring Head for Brush Surface Analyzer

The surface analyzer made by the Brush Development Co., 3405 Perkins Ave., Cleveland 14, Ohio, for checking extremely fine surface finish can now be used to accurately check rougher finishes by means of



"Magne-Blox" of Special Design Made to Suit Individual Requirements

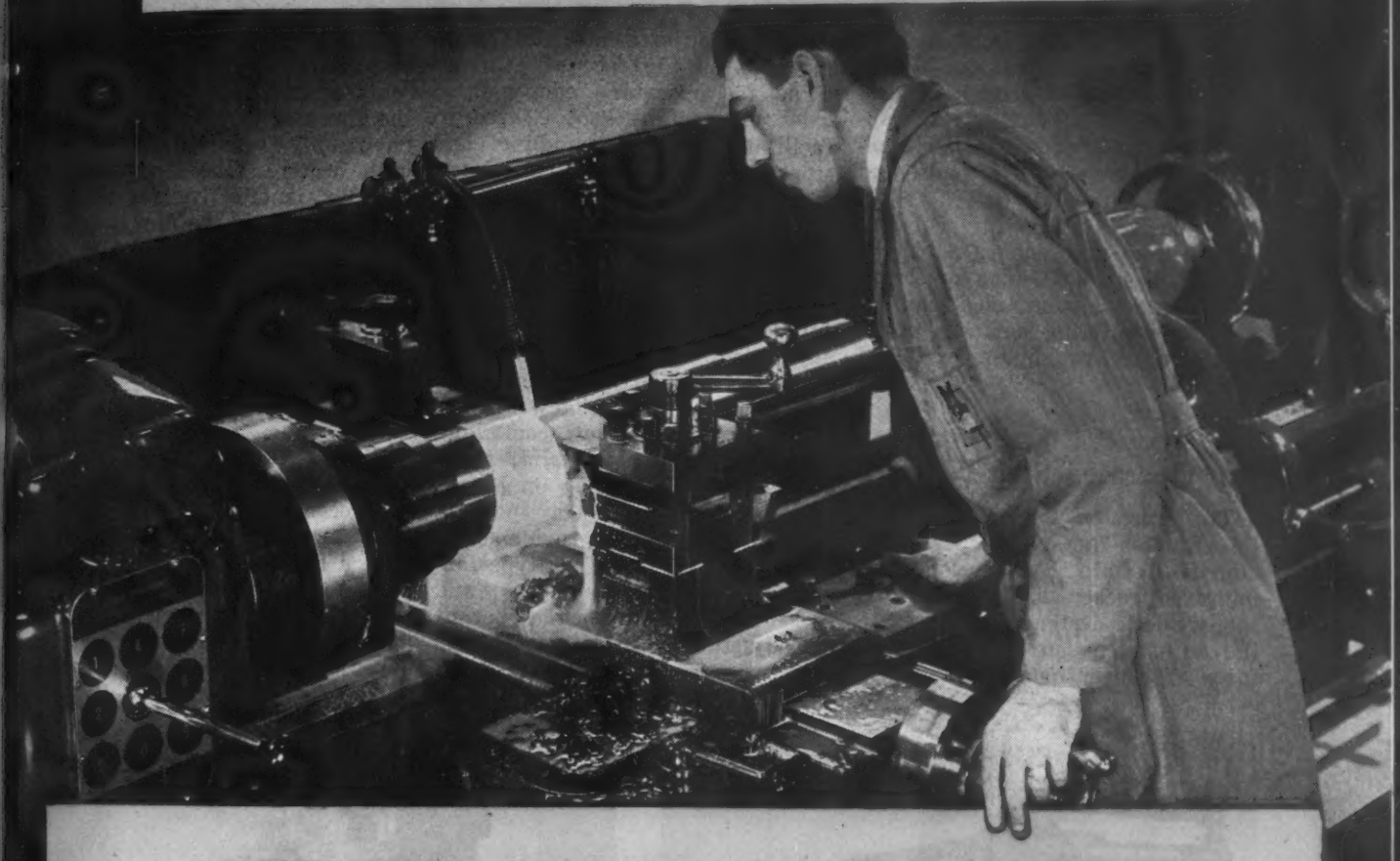


Brush Rough-finish Measuring Head Employed with Surface Analyzer

To obtain additional information on equipment described on this page, see lower part of page 214.

350 SURFACE FEET PER MINUTE

TOUGH STEEL...TOOLS TAKE IT



SUNOCO EMULSIFYING CUTTING OIL

...removes 35 cu. in. of S. A. E. 1045 steel per minute

Cut deep . . . cut fast . . . cut long—that's the task for tools today, and throughout America production men are relying on Sunoco Emulsifying Cutting Oil.

In one operation, on an American Pacemaker Lathe, they were turning S. A. E. 1045 steel at 270 RPM and taking a cut ⅜" deep. The diameter of the piece being turned was 5"—350 surface feet per minute. In every minute, 35 cubic inches of tough steel were removed . . . but the tools "took the rap" thanks to Sunoco Emulsifying Cutting Oil.

Tool life increases when tools and work are flooded with Sunoco. The outstanding cooling and lubricating qualities of this cutting oil makes possible the prevention of overheating and drawing of the temper at the cutting edge and the reduction of "down time" for tool resharpening and resetting. Chips do not seize; the tools cut cleanly . . . evenly . . . at high surface speeds.

To speed production in your plant, get the details on Sunoco Emulsifying Cutting Oil . . . and to get worthwhile factual data on all types of machining operations, write for your copy of "Cutting and Grinding Facts" to . . .

SUN OIL COMPANY · Philadelphia 3, Pa.

Sponsors of the Sunoco News Voice of the Air — Lowell Thomas

SUNOCO

SUN INDUSTRIAL PRODUCTS

OILS FOR AMERICAN INDUSTRY

a rough-finish measuring head and pick-up recently developed by this company. The range of the instrument so equipped is from 100 to 3000 micro-inches. Waviness of the finish marks on the surface is also checked with this equipment. This accessory has been designed to meet the rapidly growing need for accurate checking of rougher surface finishes and waviness, as required in the inspection of work such as shown in the illustration.

The rough-finish drive head, designated Model BL-101, has a reciprocating stroke of 3/4 inch, a complete time cycle of 9 seconds, and voltage requirements of 105 to 125 volts, 60-cycle alternating current. The pick-up unit, known as Model BL-102, has a 0.005-inch spherical-radius tracer point, and can be used in inspecting surfaces up to a maximum roughness of 0.003 inch. 80

Air-Operated Spot-Welders

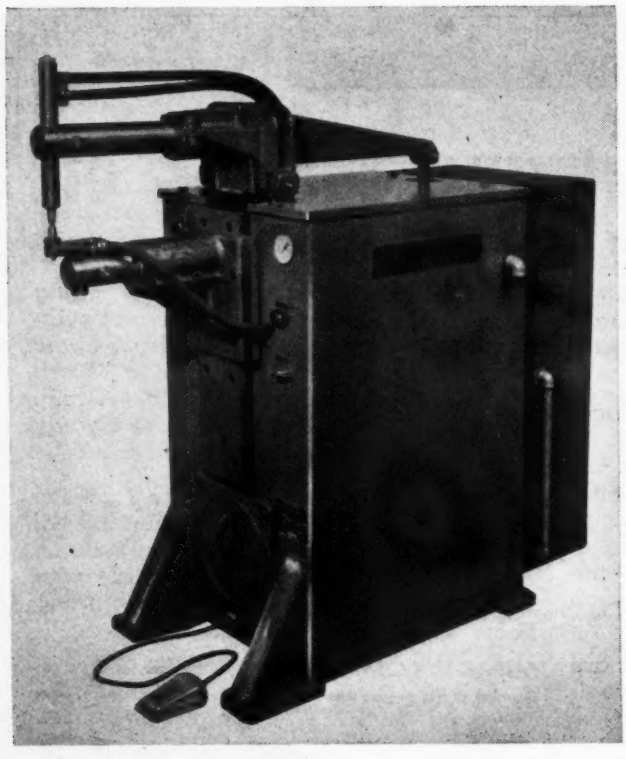
The Precision Welder & Machine Co., English and Neave Sts., Cincinnati 4, Ohio, has developed an improved rocker-arm, air-operated spot-welder, designed to embody the adjustment and function features of conventional welders and to include such improvements as unit construction developed to provide easy accessibility and to keep maintenance cost at a minimum; air terminal block designed to increase speed of operation to over 200 spots per minute and to keep piping requirements at a minimum; solenoid air valve that can be removed without disturbing piping or wiring; all water, air, and heat adjustments and gages mounted on the face of the machine for operator's convenience; sides of machine kept cleared to facilitate material handling and storage; maximum vertical adjustment in excess of 2 feet with a limit of 6 inches to insure peak efficiency with minimum demand; transformer mounting of new design, which clamps the core for its full length and provides complete adjustment for accurate and rigid mounting of the transformer; electric terminal block that simplifies field installation by combining power and control circuits; timer and contactor mounting on hinged rear panel to save floor space at sides of machine and provide access to interior; frame of box type fabrication with removable top; and socket-head cap-screws that permit all adjustments to be made with only two wrenches. 81

Lincoln "Non-Spatter" Welding Film

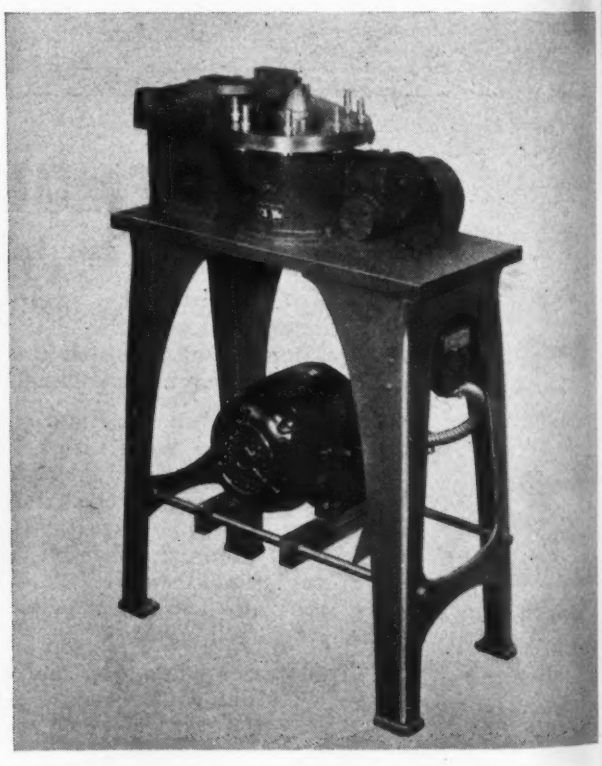
A liquid designed to minimize the adherence of welding spatter to metal and reduce cleaning time has been brought out by the Lincoln Electric Co., Cleveland 1, Ohio. This new product, known as Lincoln "Non-Spatter" film, is said to permit welding while the film is still wet. The film can be sprayed or painted on the work. Priming coats of paint can be applied over the film, and if desired the film can be readily removed by washing with water. One application of the film is effective for multiple-pass welding. If the film is sprayed or painted on parts prior to normalizing, the oxide film and ordinary scale can be removed more easily after heat-treating. 82

Rotary Marking Machine

Wm. A. Force & Co., Inc., 216 Nichols Ave., Brooklyn 8, N. Y., has recently built a horizontal rotary marking machine equipped with a mandrel table on which the parts to be marked are placed. The piece revolves on its own axis as it moves past the stationary marking die. A special mandrel support is



Air-operated Spot-welder Brought out by the Precision Welder & Machine Co.



Rotary Marking Machine for Spark-plug Bodies Made by Wm. A. Force & Co., Inc.

To obtain additional information on equipment described on this page, see lower part of page 214.

COMPARE the prices of Carboloy Tools with other tools

results

★ Available at prices as low as 70c each—actually lower in price than many sizes of ordinary tools—Carboloy "Standards" are a *"must"* on any tooling program!

Compare the prices of Carboloy "Standards"—then compare the *recognized* results of their use! With Carboloy "Standards" you can quickly increase production, often doubling or tripling machine output; save machines and manpower; reduce your tool inventory; step-up tool life to unprecedented periods of continuous use; obtain a quality of finish that substantially reduces polishing time; and effect a marked reduction in cost per piece produced.

These outstanding advantages are *immediately* available to you when you specify Carboloy "Standards". Stocked for prompt delivery in 10 styles, all common sizes, for cutting steel, cast iron, non-ferrous and non-metallics.

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Lower Cost per Piece!

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Lower Tool Inventory!

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Improved Product Quality!

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provided to prevent deflection. Each of the eight individual mandrels is separately adjustable for position by the use of eccentric bushings.

The illustration shows the machine tooled up for marking steel aircraft spark-plug bodies at approximately 1500 per hour, one operator performing both the loading and unloading operations. Units similar to the one shown have been made for marking thin-walled condenser cans. ---------- 83

Boring-Bar Holder

The Western Aircraft Tool Co., 650 N. Hoover St., Los Angeles 4, Calif., has brought out a boring-bar holder that can be set at any angle on the compound rest of a lathe. This holder provides for a wide range of vertical adjustment. The No. 1 holder has a range of 9 to 14 inches and takes 3/8- to 1/2-inch boring-bars, while the No. 2 holder has a range of 14 to 20 inches and takes 3/4- to 1-inch boring-bars. ---------- 84

Taft-Peirce Emmerton Ball-Bearing Pilot Plug Gages

A plug gage with ball-bearing pilot, developed by the Kemworthy toolmakers of London, England, to expedite inspection work in British war production plants, is now available in this country from the Taft-Peirce Mfg. Co., Woonsocket, R. I., and its agents. This plug gage has a pilot ring of hardened steel balls in an annular retainer which encircles the front end of the gaging surface. Since the balls are free to rotate in any direction, they automatically guide the gage and work into positive alignment, regardless of the angle at which the gage approaches the work.

These ball-bearing pilot plug gages enter the work under their own weight, and it is claimed that they cannot jam, either on entering or being withdrawn, even though the gage diameter is exactly the same as that of the hole being gaged. Thus, there is no danger of end wear, shearing, or burring—an especially valuable feature in protecting bores in soft metals. It is also claimed that work can be inspected more rapidly with this gage, and that even unskilled workers can use it efficiently. These gages are now available in any size from 1/4 inch up. ---------- 85

Taft-Peirce Emmerton Ball-bearing Plug Gage

Under-Water Cutting Electrodes

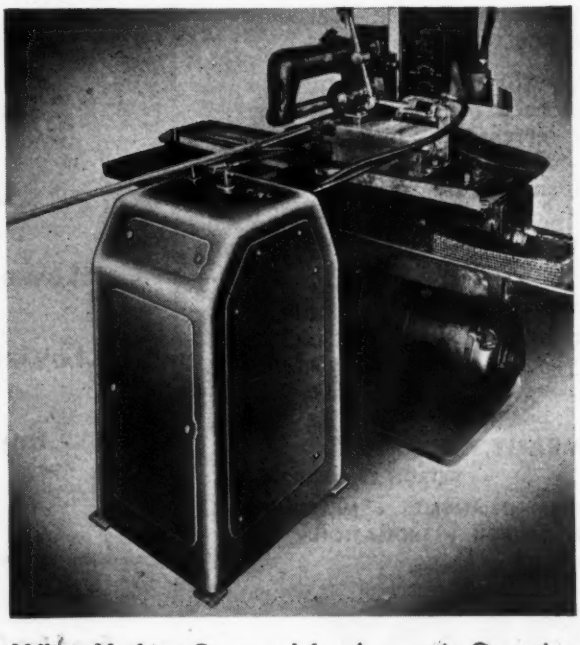
The arc-oxygen under-water cutting electrodes until recently manufactured solely for war purposes by the Metal & Thermit Corporation, 120 Broadway, New York City, are now commercially available. These electrodes utilize the heating properties of an arc flame ranging from 6000 to 10,000 degrees F. for under-water kindling of steel plate and beams to the burning point. Into the molten steel thus produced, a jet of pure oxygen is forced, to cut cleanly through the steel. So fast is the under-water cutting process that 1/2-inch steel plate has been cut under water at the rate of 52 inches a minute. An under-water welding electrode, known as Murex Type CW, is also available in 1/8- to 1/4-inch sizes. ---------- 86

Pond Fixtures Designed to Convert Machines for Automatic Operation

The Pond Engineering Co., 15 Park St., Springfield, Mass., has developed operating fixtures for converting hand-operated machines into automatics by "taking over" all manual controls except supplying the machine hopper or magazine with stock. The work is located, clamped, brought to the cutter, and removed entirely automatically, and the cycle is repeated without further attention as long as the machine is supplied with material. With this arrangement, one operator can tend several machines with less effort than was previously required for one machine.

The fixtures are operated by electrical, mechanical, and pneumatic equipment. An electric motor of 1/2 H.P. or less drives the mechanical members which, in turn, actuate the pneumatic devices. The operating fixtures are available in two models—the No. 200 used for the larger machine tools, and the No. 600 for controlling machines used for drilling, tapping, reaming, slotting, counterboring, and similar second-operation work. The No. 200, like the smaller model, is obtainable as a separate unit or as an integral part of the Pond drilling and tapping units, mounted on a standard base which permits interchanging of various small machine tool heads.

Use of the fixtures is not restricted to a single



Milling Machine Converted for Automatic Operation by Pond Control Fixture

To obtain additional information on equipment described on this page, see lower part of page 214.

KENNAMETAL—THE ALL-AMERICAN CARBIDE

Serviced by a Nation-Wide Organization

The ingredient that distinguishes steel-cutting Kennametal from other cemented carbides (the unique intermetallic compound, $WTiC_2$) is an American invention, developed in 1937 by the president of Kennametal Inc. Using $WTiC_2$ as the key ingredient, he began making Kennametal tool blanks, of graded compositions suitable for different steel-cutting purposes, in a small plant employing twelve persons, at Latrobe, Pa.

Kennametal soon became established as the tool material that made possible machining of hard steel, accurately, at economy-promoting speeds. In eight years its use has spread, until today Kennametal Inc. has grown to such stature that it successfully serves hundreds of America's major metal-working plants.

Kennametal Field Engineers are more at home in these plants than in their own offices. Their on-the-spot "know-how" enables Kennametal users to obtain optimum production from a tool material that has demonstrated amazing inherent effectiveness. Call on them—they are at your service to help you get maximum output with minimum consumption of carbide.

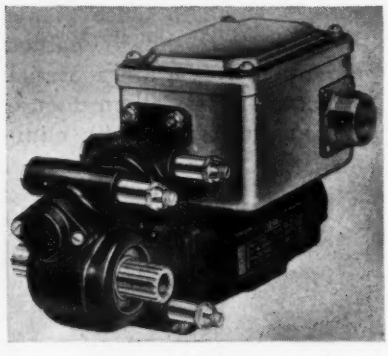
HOW YOU'VE GAINED FROM KENNAMETAL'S GROWTH

Kennametal—constantly improved throughout the years—now costs its users less than one-tenth of what it did when introduced. This price reduction has been achieved wholly because of increased production and improved manufacturing technique—the very conditions that you can help to bring about in your metal-working plant, through proper utilization of Kennametal tools.

machine or production of a single part. They can be quickly transferred to other machines or they can be readily detached if the machines are needed for hand-operation work. ----87

Lear Rotary Actuators

Lear, Inc., Piqua, Ohio, has brought out a special low-speed Model 111 series rotary actuator unit to meet demands of the aircraft and other industries. Although the unit has been in quantity production for some time, it has only recently been available to the trade. This actuator has adequate power for handling loads up to 600 pound-



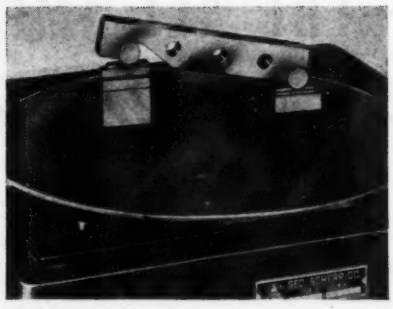
Rotary Actuator Unit Made by Lear, Inc.

inches. The unit can be operated at speeds as low as 2.2 R.P.M. Speed and output torque are varied by using different gear ratios. Production models are equipped with a double-end 5/8-inch outside diameter S A E 16-tooth spline shaft, but special output shafts are available. The output shaft rotation is normally less than 360 degrees, with reversible operation.

These units are equipped with Lear C-frame motors and Fastop clutch to insure accurate positioning of the assembly controlled. The unit is adaptable to bellcrank systems, sprocket chain drives, direct hinge drives for cooler shutter controls, landing gears, wing flaps, and other purposes. The power unit and actuator fit into a space about 8 by 4 by 5 inches, and weigh approximately 4 pounds. ----88

Scherr Sine Bars

The George Scherr Co., 199 Lafayette St., New York 12, N. Y., has added four models of sine bars

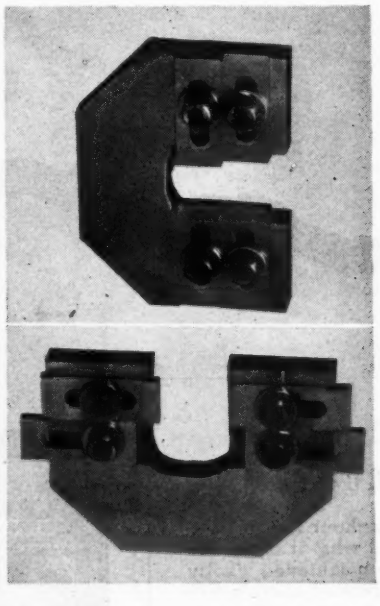


Scherr Opti-Flat Surface Plate and Sine Bar

to its line of precision measuring equipment. These sine bars are made in the following sizes: 1 by 5/8 by 5 inches and 1 by 1 1/4 by 5 inches. Both models are available in ground only, and lapped surfaces. They are thoroughly normalized by heat-treating and freezing processes. The sine bar is shown in position on the optically polished Opti-Flat in the accompanying illustration. The Opti-Flat is a new Pyrex brand glass surface plate which can also be supplied by this company. ----89

Adjustable Snap, Depth, and Width Gages

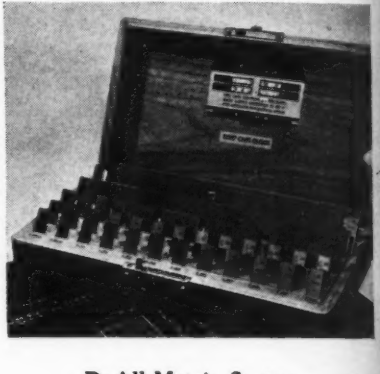
A gage designed for inspection, production, or tool-room use, which consists essentially of a U-shaped holder and adjustable gaging blades that can be set for use as a "Go" and "No Go" snap, depth, or width gage, has been placed on the mar-



Adjustable Snap and Depth Gages Made by Massey Machine Co.

ket by the Massey Machine Co., 800 Pearl St., Watertown, N. Y.

When used as a snap gage for checking shaft diameters, the gage is set, as shown in the upper view of the illustration, by pushing the blades together against a precision size-block and tightening the socket clamping screws. The front pair of blades is set for the "Go" size, and the back pair for the "No Go" to any given tolerance. When used as a depth gage for keyways and counterbores, the blades are extended outward and set by means of size-blocks so that the distance from the outer end of one blade to the end of its adjacent blade will be a "Go" dimension on one side and a "No Go" on the other, as shown in the lower view. The gages are made in four sizes ranging in capacity from 0 to 3/4 inch up to 2 1/4 to 3 inches. ----90



DoAll Metric System Gage-blocks

DoAll Metric Gage-Blocks

A new series of metric gage-blocks designed to meet the needs of domestic and foreign manufacturers using the metric system is being introduced to the trade by Continental Machines, Inc., 1312 S. Washington Ave., Minneapolis 4, Minn. These blocks are made in two grades that correspond in accuracy with the English system blocks. Inspection accuracy is guaranteed by the manufacturer within plus or minus 0.0001 millimeter and working accuracy to within plus or minus 0.0002 millimeter. Although calibrated in the metric system, the blocks can also be used to make up English system combinations.

The set, consisting of thirty-eight blocks plus two tungsten-carbide wear blocks, can be used to make up over 100,000 gaging com-

To obtain additional information on equipment described on this page, see lower part of page 214.

These Small Chicago Wheels MAKE INDUSTRY HUM!

CHICAGO GRINDING WHEELS AND MOUNTED WHEELS

Millions of whirling abrasive wheels, trained in war's tough school of precision finishing, each doing a prime job in laboratory, tool room, aboard ship, on production line. And — they're all set and eager to tackle civilian goods when peace machinery is singing again.

Whether it's removing burrs, smoothing edges, squaring surfaces so accurately that the finish can be measured in micro inches, or cut-off work—there's a Chicago ready to do a top-ranking job for you.

VITRIFIED GRINDING WHEELS with a 50-year pedigree. Up to 3" in diameter in various abrasives and bonds including the famous FV Bond.

MOUNTED WHEELS. The largest assortment made with a shape and abrasive to take care of every internal and external finishing job.

CUT-OFF WHEELS. All types and sizes. Now offered with the sensational new special-formula RT Bond (rubber or resinoid).

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1101 W. Monroe St., Dept. MR, Chicago 7, Ill.

SEND FOR TEST WHEEL

Learn first-hand about Chicago's superiority. Tell us what you have to finish, size wheel you'd like and we'll mail one promptly.

★ Half a century of specialization has established our reputation as the Small Wheel People of the Industry.

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Name _____

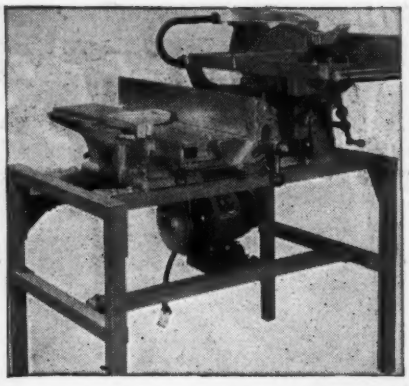
Address _____

binations ranging from 1.01 millimeter to 100 millimeters in increments of 0.01 millimeter. A 1.005-millimeter block makes possible special combinations for closer tolerances. The blocks are manufactured from high-carbon chromium steel, and are guaranteed to exceed a hardness of 65 Rockwell C. 91

Unistrut Framing and Support System

Metal frames, machine tables and bases, stock racks, and supports for a variety of equipment can be easily and quickly constructed right on the job by means of a new method developed by the Unistrut Products Co., 1060 W. Washington Blvd., Chicago, Ill. Unistrut framing consists of slotted hollow square steel or other metal sections and standard spring-held nut attachments, such as used in constructing the supporting frame for the machine shown in the accompanying illustration. This framing material does not require the drilling of holes, riveting, or welding, and can be cut to any desired length with a hacksaw.

The nut attachment can be slid along the slots in the framing to any point or points where it is desired to attach it to another Unistrut member, a supporting structure, or to the floor, ceiling, or wall. The Unistrut nut has serrated teeth which bite into the inturned edges of the hollow square section and hold the attachment firmly in position when the nut is tightened with an ordinary wrench. However, the nut can be easily loosened, the attachment moved to a new location, and again securely fastened in place. The structural



Machine Table and Legs Constructed from Unistrut Framing Members

members are furnished in sections of several sizes or gages, usually in lengths of 16 or 20 feet, but they are also available in shorter lengths. 92

Granite Surface Plates

The Ideal Commutator Dresser Co., 1011 Park Ave., Sycamore, Ill., is introducing to the machine-building industries a line of precision ground and lapped surface plates made in a wide range of sizes from edge-grain Vermont granite. Since granite is the third hardest natural substance known, being exceeded in hardness only by the sapphire and diamond, these surface plates are said to be harder than glass or steel.

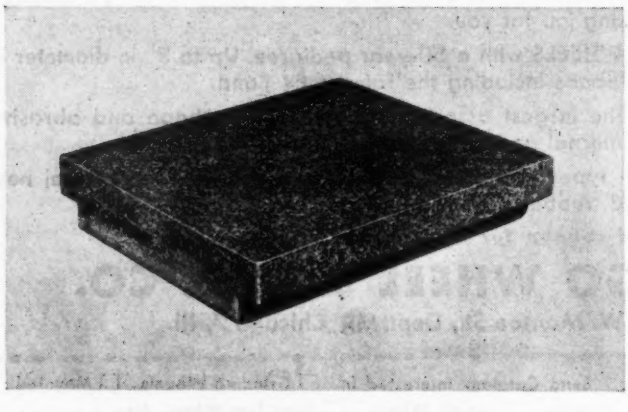
Thorough aging in the ground for many thousands of years has served to relieve the granite of internal stresses, so that surface plates made from this material will not warp or change shape with variations in temperature or with age. Another advantage of this material is that nicks or scratches do not raise burrs to affect the accuracy of the lapped surface. Having a low coefficient of friction, the granite plates permit tools and fixtures to be easily moved about on their lapped surfaces. Being non-magnetic, they will not attract and hold iron chips or dust. They are rust- and corrosion-proof, and can be readily cleaned with soap and water or any commercial solvent. Although acids may discolor the plates, they will not attack them.

These granite surface plates are regularly made to an accuracy of 0.0001 inch in fourteen sizes ranging from 8 by 10 to 24 by 48 inches, and weighing from 32 to 680 pounds; to an accuracy of 0.0002 inch in five sizes ranging from 30 by 30 up to 30 by 72 inches, and weighing from 550 to 1700 pounds; to an accuracy of 0.001 inch in nine sizes ranging from 24 by 24 up to 30 by 72 inches, and weighing from 232 to 1700 pounds. Granite surface plates of larger sizes can be furnished on special order. 93

Universal Tool-Holder

A universal tool-holder of radically new design, which is available in three sizes for use on planers, shapers, and lathes, has just been announced by the Symmetric Mfg. Co., 147 W. Alameda Ave., Burbank, Calif. This holder accommodates carbide-tipped tool bits, as well as parting, threading, facing, forming, and boring tools of any regular size and length. It can also be used to hold dial indicators.

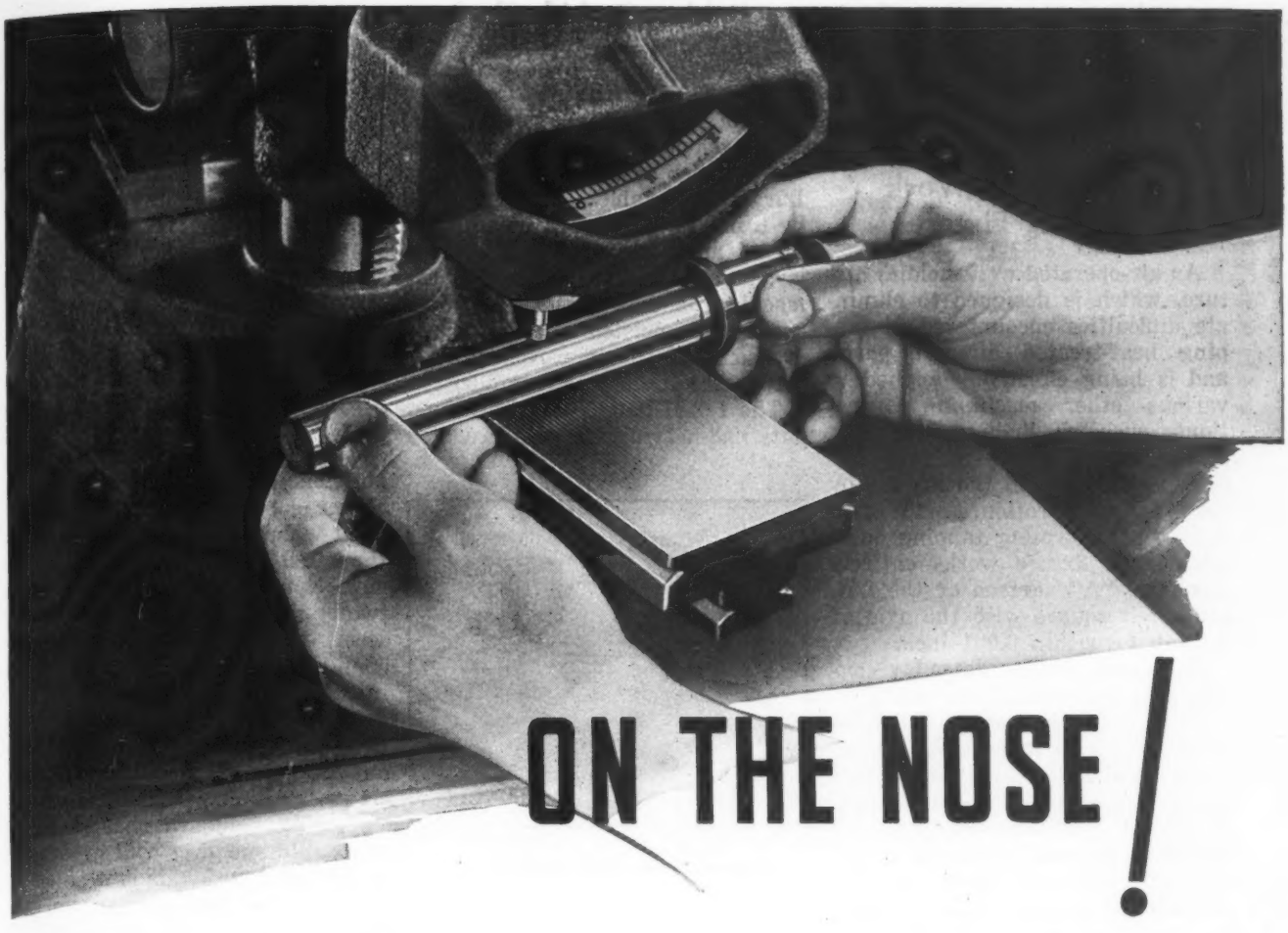
The holder can be quickly adjusted to any position for either external or internal work without



Granite Surface Plate Manufactured by the Ideal Commutator Dresser Co.

Universal Tool-holder Brought out by the Symmetric Mfg. Co.

To obtain additional information on equipment described on this page, see lower part of page 214.



ON THE NOSE!

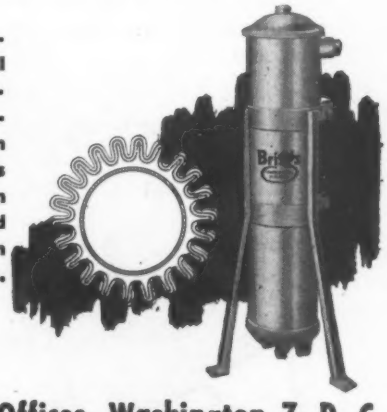
Clean Coolant Helped...

Effective filtration of coolants or cutting oils may be the solution to your "percentage of rejects" problem. Reduce that percentage and you'll increase your production just that much!

Briggs Coolant Filters . . . with unique Z-fold refill cartridge . . . have shown remarkable results wherever they have been installed. On one machine, production was doubled . . . on another machine, increased production paid for the Briggs filter the first day it was installed. In addition—coolant life was doubled . . . wheel and tool life considerably extended.

Briggs Filters are available for unit machines or for central systems. Capacities range from 3 GPM to 100 GPM.

Look in your local classified telephone directory under "Filter" . . . locate the Briggs distributor . . . have him show you the difference between Briggs Filters and ordinary filters. Or—write direct to manufacturer for illustrated literature.



Unique design and construction of Z-fold refill cartridge provides greatest possible filtering surface area and maximum flow rate. Cellulose is specially processed...from raw material to finished product . . . for filtration of liquids used as coolants.

BRIGGS CLARIFIER CO. **Briggs** PIONEERS IN MODERN OIL FILTRATION **General Offices, Washington 7, D. C.**

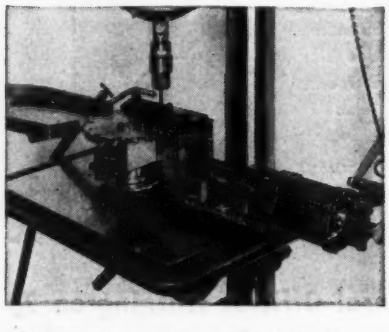
removal from the toolpost. Simply loosening the head bolt with a standard lathe wrench releases the tool for resetting. 94

Air-Operated Work-Holding Fixture

An air-operated work-holding fixture, which is designed to eliminate difficulties encountered in tapping heat-treated aircraft parts, and is being effectively applied to various other machining operations, such as drilling, reaming, countersinking, and milling, has just been placed on the market by the K & H Corporation, Fort Wayne, Ind. In performing tapping operations, the fixture works entirely from the "A" surface of the nut, holding it square with the axis of the tap to within 0.001 inch.

The entire fixture assembly consists of a double-action air cylinder; a plunger, which is made hollow to permit effective disposal of chips; a pawl and indicating mechanism; and a cam and seat mounted on a frame. A coolant pump supplies a good flow of clean cutting oil to the tap, and also serves as an effective means of removing chips. Successful operation on air at 35 to 40 pounds line pressure is obtained by the use of a 3 to 1 ratio cam operated by an air cylinder having a 4.9 to 1 power increase over the regular factory air-line pressure. The indexing mechanism is operated by the return stroke of the double-action cylinder.

With this fixture, one operator can tap over 18,000 1/4-28NF3 aircraft nuts in eight hours. The production records on several millions of these nuts in shops using this air-operated fixture show scrap rejections of less than 1/100 of 1 per cent. 95

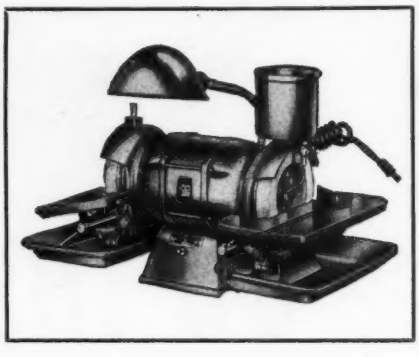


K & H Air-operated Work-holding Fixture Applied to Drill Press

Baldor Carbide-Tool Grinder

The Baldor Electric Co., 4400 Duncan Ave., St. Louis 10, Mo., has developed an improved carbide-tool grinder designated Series 500. Larger tool tables, measuring 12 by 6 inches, which can be adjusted up to an angle of 45 degrees, a large water pan at each end of the machine, and a water pot with spout for moistening the wheels are some of the improvements incorporated in this new grinder.

The 1/2-H.P. 3400-R.P.M. heavy-duty ball-bearing motor with which



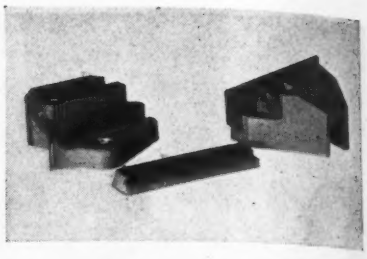
Baldor Series 500 Carbide-tool Grinder

this grinder is equipped can be reversed to facilitate sharpening either right-hand or left-hand tools as required. 96

Landis "Lanrac" Chasers and Holders

The Landis Machine Co., Waynesboro, Pa., has developed a new chaser and chaser-holder combination designed to simplify the interchanging of chasers and to impart greater rigidity and strength to these members, in order to insure the production of threads having a higher degree of accuracy. The new "Lanrac" chaser and holder employs a rack-tooth arrangement which provides for the quick location of the chaser in approximately its correct position.

The chaser has rack teeth milled for its full length on the offset seating surface. Rack teeth are also milled on the chaser clamp at the end nearest the chaser cutting edge. In interchanging chasers, the chaser is simply placed on the holder in its approximate position



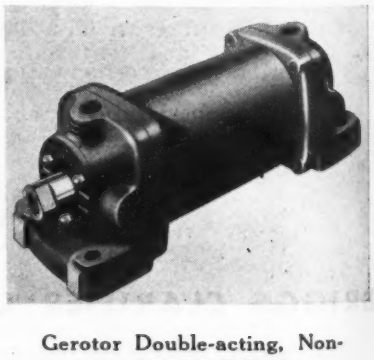
"Lanrac" Chasers and Holders

and clamped lightly. An adjusting screw which engages the back end of the chaser clamp is then employed to advance the chaser and chaser clamp as a unit to the exact position. Elongated slots in the chaser clamp permit a lateral movement which is slightly greater than the pitch of the rack. With this new clamping arrangement, only two or three turns of the adjusting screw are necessary when interchanging chasers to bring them into their correct positions.

"Lanrac" chasers can be used with old type chaser-holders without the use of the "Lanrac" type clamp. All new Landis die-heads employing standard chasers 15/16 inch wide and over will eventually be equipped with this new patented chaser-holder and chaser combination. 97

Gerotor Air Cylinders

A new line of double-acting, non-rotating air cylinders has been announced to the trade by the Gerotor May Corporation, 444 Tacoma Ave., Logansport, Ind. A keeper ring is used to insure leak-proof construction of this air cylinder and permit the covers to be rotated to any desired position for making pipe connections. The keeper ring construction also permits a more compact design of the cylinder, and



Gerotor Double-acting, Non-rotating Air Cylinder

To obtain additional information on equipment described on this page, see lower part of page 214.

10 Different types of prints can be made with Ozalid

You specify the type of print desired—whenever you want reproductions of your engineering drawings, office forms, or other originals.

For some jobs, you may prefer a black-line print to a blue-line or red-line print. Or you may prefer the reproduction on cloth, instead of on paper, foil, or film.

Each type of print has its advantages.

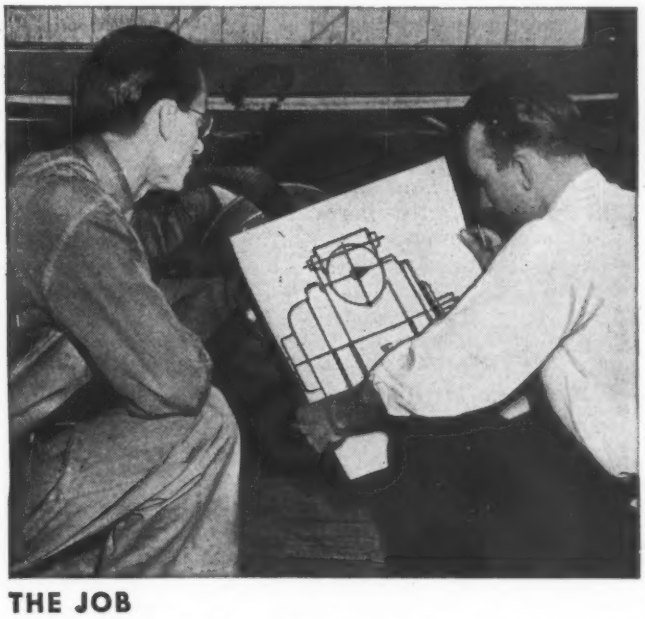
But no matter what type of print you choose, it's made in an OZALID MACHINE in the same manner, in seconds . . . for OZALID is a unique reproduction process which, besides giving you a 10-1 advantage, greatly simplifies printmaking.

THE JOB

Sixteen copies of this three page, typewritten report are needed right away.

The Ozalid Print for the Job

OZALID RAPID BLACK because you'll get prints which you will think were actually typed . . . and they'll be smudge-proof besides. You can also copy form letters . . . and type in headings that will exactly match the printed images. In addition, OZALID RAPID BLACK may be used for all-purpose work.



THE JOB

Part of this design must be changed before production can begin.

The Ozalid Print for the Job

OZALID TRANSPARENT CLOTH because an extremely durable "intermediate" print is desired. The obsolete lines on the print can be removed with Ozalid Corrector and the new design drawn in. The Transparent Cloth intermediate is then used to produce the desired number of prints for the production line.

THE 10 TYPES OF OZALID PRINTS

For efficiency in routine jobs • For "impossible" jobs

1. **Black-line**
2. **Blue-line**
3. **Red-line**

   For routine prints in drafting room, shop, or office.
4. **Opaque Cloth**

   For exceptionally durable prints, file copies, etc.
5. **Transblack Intermediate**
6. **Sepia-line Intermediate**
7. **Transparent Cloth**

   For producing "intermediate originals" or to save time and labor when making design changes.
8. **Transparent Foil**

   For making composite prints; reclaiming old, or worn originals.
9. **Chartfilm**

   For producing lustrous, black-line prints on white plastic base—oil proof and waterproof.
10. **Dryphoto**

    For high-quality reproductions of any photographic subject: in black, sepia, or two-tone effect.

Write for Free Samples of Ozalid's Ten Types and complete information.

Write **OZALID**

Division of General Aniline and Film Corporation
Johnson City, N. Y. Ozalid in Canada—Hughes-Owens Co., Ltd., Montreal.

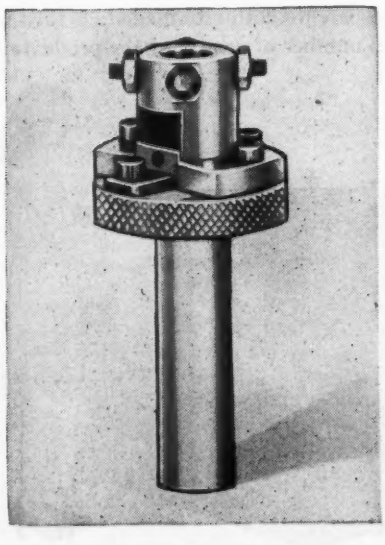
allows it to be easily installed where a minimum amount of space is available.

The cylinders can be used for No. 150 air and No. 130 oil and water service. Those used for "oil hydraulic" service can be had with auto-type piston-ring construction. Self-adjusting composition packings are used for the cups and piston-rod, and have been selected for the three services to provide long life and operation with a minimum amount of friction.

Other Gerotor air cylinder features include large pipe connections; ample bronze-rod guide; over-size alloy piston-rod; heavy-duty piston assembly; and heavy-duty alloy covers. These double-acting, non-rotating air cylinders are available in seven standard mountings, with bores of twelve different diameters, and in any desired length of stroke. 98

Precision Centering Reamer-Holder for Hand or Automatic Screw Machines

A new principle for obtaining true-center reaming is incorporated in the design of a precision centering reamer-holder now being manufactured by Lavallee & Ide, Inc., Grape St., Chicopee, Mass. This holder is adapted for reaming super-finished holes to very close limits; tapping Class 3 fit threads; threading with self-opening dies; special form-reaming; counterboring; and precision drilling.

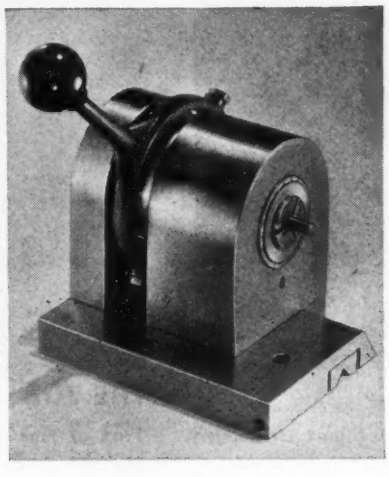


Reamer-holder Manufactured by Lavallee & Ide, Inc.

It is set with an indicator to establish the true center line position in order to compensate for errors in chucks, turrets, etc. Once this true center is established, reamers can be interchanged freely in any size within the capacity of the holder without the use of bushings or adapters. Stub reamer and chucking reamer heads of 1/16 to 7/16 inch capacity, and a chucking reamer head of 7/16 inch to 1 1/8 inches capacity, are available. 99

Zagar Special Collet Type Speed Chuck

A special collet chuck for grinding studs and other parts that can be held in a collet has been made

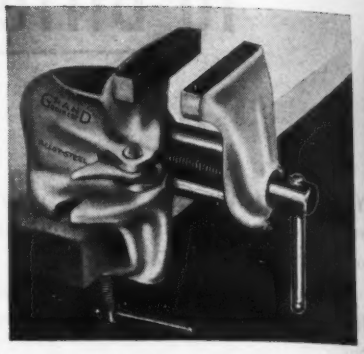


Zagar Speed Chuck Made for Use on Grinding Machine

by Zagar Tool, Inc., 23880 Lakeland Blvd., Cleveland 17, Ohio, for attachment to a grinding machine. Most of the collet closing mechanism of this chuck is assembled from standard parts of the regular Zagar 1-inch collet fixtures. The collet does not move lengthwise in opening and closing, which is a very important feature in grinding parts to shoulder dimensions. 100

"Quikcet" Machinist's Vise

A vise that can be quickly set or closed by simply pushing inward on the body of the free jaw has just been introduced to the trade by the Grand Specialties Co., Grand Ave. at Troy, Chicago 22, Ill. The free jaw slides on the ratchet clamping screw and two precision guide rods, and is tightened by a



"Quikcet" Vise Made by Grand Specialties Co.

turn of the handle. The vise is equipped with a trigger release pawl having a 3/4-inch length of thread, which holds the hardened screw under spring tension. The vise opens instantly to a full 3 inches between jaw faces by simply pressing the thumb or finger on the trigger release after the tension has been eased by a single turn of the handle.

The serrated and hardened jaws are integral with the vise body. The vise is "spatter-proofed" for use in welding by copper-plating all working parts and handles, and is rustproofed with gray enamel finish. It is also equipped with a polished handle and a bottom clamping screw which permits quick shifting of the vise from one bench to another. The usual slots are provided for holding the vise to the bench. 101

Inside Micrometer Gage

The U. S. A-C-E Tool Gage Co., 827 S. Hoover St., Los Angeles 5, Calif., has brought out an inside micrometer and gage, which is designed to measure the width of grooves 1/32 inch deep and over in "through" or blind holes, and is intended for use in making close fits requiring accuracy to 0.0001 inch. The dimension or measurement of the depth is shown on the gage stem. A lock-nut is provided to hold the setting. The range of the gage, reading in 0.001 inch, is from 0.400 inch to 1.500 inch, and the total calipering range is from 0.250 inch to 3.1875 inches. Attachable ball points that add 0.500 inch to the caliper range can be furnished. The measuring range can also be increased to 4.250 inches by using extension points. 102

To obtain additional information on equipment described on this page, see lower part of page 214.

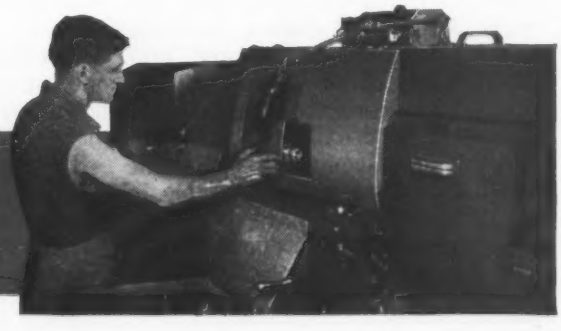
CHUCKING MACHINE EFFICIENCY 89.6%

Each time the ticking sound of a watch movement is heard, important phases of life begin and end. Whether it be in the form of a service-man's watch or in the delicately assembled timing device of an anti-aircraft shell, time must be accurate and dependable. Making good time for the past eighty-eight years, the U. S. Time Corporation of Waterbury, Connecticut, has devoted their entire experience and effort since Pearl Harbor supplying precision-built instruments of war.

The clockwork in the fuse body of an ack-ack shell governs the instant of explosion. A flaw in the manufacturing of this timing device or the brass fuse body in which it rests could result in a major catastrophe. To assure perfection, the first and second operation on the fuse body has been produced for the past three years on a battery of Model 656 New Britain Multiple Spindle Automatic Chuckers. The leaded brass forgings are machined at the rate of 237 fuse bodies per hour per machine, with carbide tip tool life running 2500 to 3000 pieces per grind. This machine performance, coupled with competent personnel and an organized inspection requiring 36 gauging operations, has made it possible to achieve the unheard of machine efficiency of 89.6%. This story is but one of the many New Britain case histories of the present war effort . . . superior productivity that can automatically be the tip-off to your winning peacetime manufacturing battles . . . quickly and economically. Consult with our Sales-Engineer in your area or, should you prefer, communicate direct.

NEW BRITAIN AUTOMATICS

THE NEW BRITAIN MACHINE COMPANY
NEW BRITAIN, CONNECTICUT
New Britain-Gridley Machine Division



M-01015

Why Magnesium Will be One of the Important Metals of the Future

THE most striking quality of magnesium is its lightness. Its weight is only 23 per cent that of iron and 64 per cent that of aluminum. Wherever there is mass in motion, lightness may lead to reduced operating costs, better performance, and more payload. In designs where there is a limitation on weight, the use of light materials permits the specification of thicker and stiffer sections without a weight penalty. Comparisons of cost with other materials should take the lightness of magnesium into account, because, on a volume basis, it may mean a lower material cost.

Magnesium, like most other metals, is relatively weak in its pure state. By alloying with small amounts of other metals, however, its strength is greatly increased. Because magnesium alloys have excellent strength-weight ratios, they should have many structural applications. Proper design factors must be used for applications at elevated temperatures, because heating will affect the mechanical properties. The use of magnesium alloys for structural purposes at temperatures over 400 degrees F. is not recommended. At sub-normal temperatures, magnesium alloys undergo only negligible changes of strength. Although the modulus of elasticity of magnesium alloys is lower than that of other structural metals, magnesium parts can usually be designed to be stiffer in flexure than other metal parts of the same weight.

Magnesium alloys are adaptable to modern processes of fabrication and assembly, and are available in most commercial forms. They are cast in sand, in permanent and semi-permanent molds, and in die-casting machines. In wrought form, they are rolled into sheet and plate, extruded into rod, bar, and wire, structural shapes, molding and tubing, and are forged into hammer and press forgings. Other forms include rolled strip, ribbon, and alloys for deoxidizing purposes. The range of commercial sizes in which these forms are available is wide. Castings range in weight from a fraction of an ounce to well over 700 pounds.

Magnesium alloys possess remarkable machining characteristics which contribute to the economic success of many applications. Machining operations are very fast, and a smooth finish is readily obtained. Magnesium alloys can be joined by torch welding and by electric resistance and spot welding. Riveted joints in magnesium alloys should be made with 56S aluminum-alloy rivets.

The best commercial magnesium alloys usually resist the action of inland atmospheres satisfactorily, although some surface attack of the uniform etching type may occur. Precautions should be taken to prevent moisture being trapped in crevices or low spots, if corrosion is to be avoided. In general, salt water and salt spray are corrosive to magnesium, and may cause severe attack. Unless it is known that the environment and conditions of service are not detrimental to magnesium, it is advisable to protect the magnesium parts with a suitable chemical coating followed by painting; this will provide adequate protection against corrosive agents.

An important factor in evaluating the cost of a magnesium-alloy structure compared to one using the ferrous metals, is the high scrap value of magnesium. After a magnesium product has served its useful life, the metal still has a comparatively high potential value as scrap for remelting and subsequent use.

Other characteristics of magnesium which may be used to advantage in some applications are its relatively high coefficient of thermal expansion, its low electrical conductivity, and its non-magnetic property. Magnesium has good etching qualities for photo-engraving work, is valuable in certain chemical and metallurgical processes for its deoxidizing properties, and possesses usefulness as a constituent in the alloys of aluminum and zinc.

One-Hundredth Anniversary of Thomas Prosser & Son

The firm of Thomas Prosser & Son, 120 Wall St., New York City, which is celebrating its one-hundredth anniversary this year, was founded in 1845 by Thomas Prosser, great-grandfather of the present head of the firm. The company has been controlled through all these one hundred years by members of the same family — successively by Thomas Prosser, Thomas Prosser II, Thomas Prosser III, Richard Prosser, and at present by Roger D. Prosser. The firm was originally established at 15 Gold St., New York City, and continuously occupied offices in that building for over ninety-two years. In 1937, the company moved to its new offices at 120 Wall St. It is one of the oldest firms in the downtown New York business district.

Thomas Prosser & Son have been pioneers in fine steel products and mechanical specialties ever since 1845. The first lap-welded boiler tubes ever used in this country were made under the patent of Richard Prosser of Birmingham, England, and imported into New York by Thomas Prosser in 1845, causing a revolution in boilermaking practice. Since the new tubes permitted higher steam pressures, it was necessary to provide tighter joints between the tubes and the boiler head. The first boiler-tube expander was invented by Thomas Prosser in 1849, and the Prosser type sectional expander is still used by railroads and boiler shops throughout the country.

In 1927, Thomas Prosser & Son introduced on the American market the first piece of cemented carbide for cutting tools. In 1933, the firm introduced, commercially diamond-impregnated wheels and hand laps for grinding hard composition tools. These wheels were first imported from England. In 1935, the firm designed the first grinder especially intended for grinding carbide tools.

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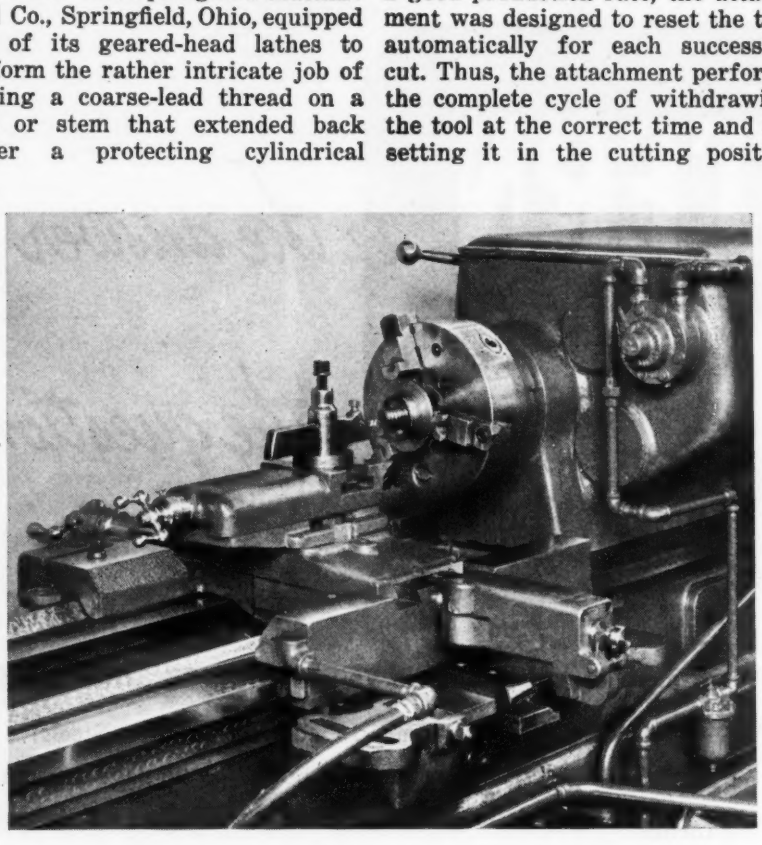
Special Threading Attachment for Geared-Head Lathe

The accompanying illustration shows how the Springfield Machine Tool Co., Springfield, Ohio, equipped one of its geared-head lathes to perform the rather intricate job of cutting a coarse-lead thread on a hub or stem that extended back under a protecting cylindrical flange or shelf. It was necessary that the thread terminate under the shelf at a predetermined point, no relief being allowed for clearance. Hence, the attachment was designed to withdraw the tool at a given point on each cut.

In order to thread the pieces at a good production rate, the attachment was designed to reset the tool automatically for each successive cut. Thus, the attachment performs the complete cycle of withdrawing the tool at the correct time and resetting it in the cutting position as the carriage is run back to the starting point by the lathe reversing mechanism. The resetting of the tool on the return movement of the carriage is accomplished by means of a dog on the back of the attachment mechanism.



Geared-head Lathe Equipped with Attachment for Automatically Withdrawing and Resetting Tool Used in Cutting Thread on a Hub that Extends under Flange

Wendt-Sonis Uses New Method of Rust Prevention

A new method of rust prevention on precision tools has been developed by the Wendt-Sonis Co., Hannibal, Mo., manufacturer of all types of carbide-tipped tools. To eliminate the gummy residue resulting from ordinary rust-preventing applications, the company applies a film of a new rust preventive compound on each tool as it leaves the factory. As a result, the tools require no dewaxing or degreasing before being inserted in a toolholder. In addition to this protection from rust, the carbide tips are protected from chipping by applying plastic caps over them.

* * *

Heavy taxation of corporate earnings is a direct invitation to unemployment because such taxation takes large funds away from business at the very time when these funds could be used to increase production and create more jobs.

Recent Army-Navy "E" Production Awards

The Taft-Peirce Mfg. Co., Woonsocket, R. I., has won for the fifth time the Army-Navy "E" Production Award for outstanding service in the production of war equipment. The Buffalo Forge Co., Buffalo, N. Y., the first manufacturer to receive the Army-Navy "E" for excellence in the production of fans, has also been awarded this honor for the fifth time, as has also the Wyckoff Steel Co., Pittsburgh, Pa.

The Pangborn Corporation, Hagerstown, Md., has received the Army-Navy "E" Award for the fourth time for meritorious service and continued production achievements in blast-cleaning and dust-control equipment for use in armament production.

The Farrel-Birmingham Co., with plants at Ansonia and Derby, Conn., and Buffalo, N. Y., has received the Navy "E" Award for the sixth time, entitling the company to display the Navy "E" flag with five stars.

The Bantam Bearings Division of the Torrington Co., South Bend, Ind., has been awarded the fifth Army-Navy "E."

* * *

"Spark" Drilling

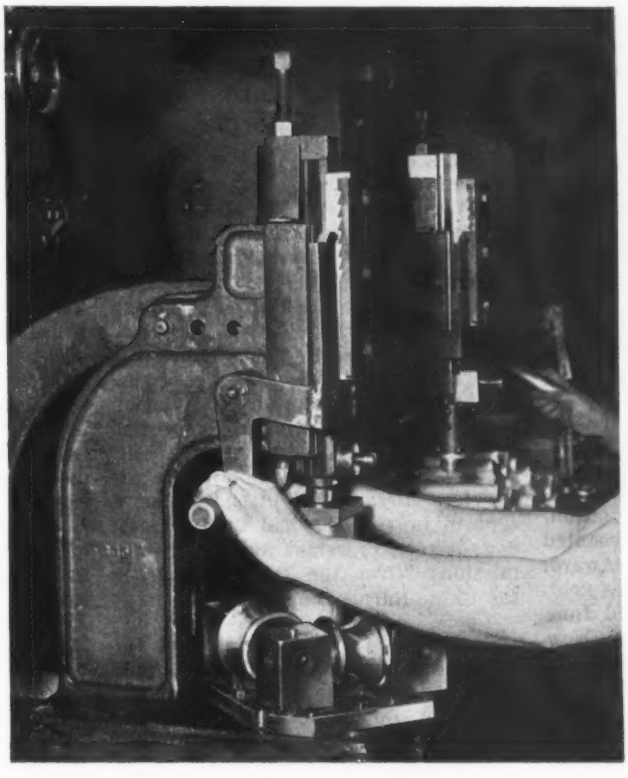
The Elox method of electrical disintegration for removing broken taps, drills, reamers, and studs from machined parts has been used in American industry for over two years. The Elox Corporation, 838 Maccabees Bldg., Detroit 2, Mich., has now extended the application of electrical disintegration equipment to what is known as "disintegrator drilling." By this means, shaped holes in hard or soft steel can be produced by using either a solid or hollow electrode. Square and triangular holes, as well as irregular holes, can be produced in this manner. Other applications are being developed for the disintegrating machine, especially in the fields of diemaking.

* * *

Despite the tremendous wartime merchant shipping losses suffered by the United Nations, this tonnage had been replaced before the end of 1943 by production in American shipyards.

Press Safety Device

The accompanying illustration shows a kick-press safety device originated by C. S. West, of the Pittsfield Works, General Electric Co. This is another of the effective safety devices in which the operator must use both hands to make the press function. A steel plate with ratchet teeth is securely fastened to the movable slide head. Unless the hand-levers on both sides of the head casting are pulled forward, locking dogs will prevent the downward travel of the slide head. It is said that in addition to insuring safety, this device has lessened fatigue, because it permits the operator to brace herself in a normal manner when applying pressure on the foot-pedal.



Effective Press Safety Device

* * *

Aviation Meeting of A.S.M.E.

An Aviation War Conference sponsored by the American Society of Mechanical Engineers was held at the University of California, Los Angeles, Calif., June 11 to 14. Among the many subjects discussed by aviation engineers at this meeting were gas turbines and jet propulsion, instruments and regulators, metals engineering and production in the aviation field, and the application of rubber and plastics in aviation.

* * *

Simplified Practice Recommendation for Abrasives

Printed copies of Simplified Practice Recommendation R118-45, Abrasive Grain Sizes, are now available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., at 5 cents each. This recommendation became effective April 1, 1945, and covers grain sizes for aluminum-oxide and silicon-carbide abrasives for grinding and polishing uses and grinding wheel manufacture.

Nitrogen as an Alloying Element in Steels

The element nitrogen, which steelmakers for years have considered highly undesirable, has recently proved itself a valuable addition to certain steels. The initial use of nitrogen, of course, came with the introduction of the nitriding process of casehardening, but this seems to have had no direct connection with the subsequent development of nitrogen as an alloying element in steel production.

As a general rule, all steel contains a very small, almost infinitesimal, amount of nitrogen. This is picked up from the atmosphere in the smelting process, but the amount is too small to have any noticeable effect on the properties of the metal. When present in somewhat larger percentages, however, nitrogen has been found to have a most important effect on practically all chromium steels. The effect is most pronounced in the case of those containing over 11 per cent chromium.

Metallurgists believe that the nitrogen combines to form either chromium nitrides or iron chromium nitrides. When the ratio of nitrogen to chromium is below about 1 to 100, the nitrides seem to remain in solution in the steel at all temperatures.

In the martensitic (or hardenable) type of stainless steels, the effect of nitrogen is like that of carbon in that it increases the hardness and tensile strength; but, unlike carbon, it has little or no effect upon toughness or resistance to corrosion. The same is approximately true for the ferritic, non-hardenable 16 to 18 per cent chromium steels.

In the case of the 20 to 30 per cent high-chromium steels, the effects of nitrogen are extremely marked. Here, the result is to increase both the ductility and the strength. In the case of the 18 and 8 chromium-nickel austenitic steels, the addition of nitrogen has the effect of improving the tensile strength materially without impairing either the ductility or the corrosion resistance.—*Archibald Black in a paper presented before the American Society of Mechanical Engineers*

* * *

What Will Raise Scale of Living?

Samuel Pettengill, in his introduction to a clear and concise article by Dr. Willford King on "Raising the Workingman's Scale of Living," obtainable from the Committee for Constitutional Government, Inc., 205 E. 42nd St., New York City, answers the question "What will raise the standard of living?" in very simple words. According to Mr. Pettengill:

"The standard of living will be raised by continuing to expand the output per worker, which requires still better tools and more highly skilled men, which calls for new capital, which requires men who save. But men can and will save only if the Government does not tax their savings away and does not prevent them from earning a fair return."

News of the Industry

William I. Beach, Who Recently Received the John Wesley Hyatt Award for Distinguished Contributions to the Plastic Industry

California and Washington

WILLIAM I. BEACH, chief plastics engineer for North American Aviation, Inc., Inglewood, Calif., was presented with the John Wesley Hyatt Award, the highest honor in the plastics field, at the annual award dinner held June 14 at the Waldorf-Astoria Hotel, New York. The award was established in 1941 by the Hercules Powder Co. "for distinguished contributions to the plastic industry." Mr. Beach received the degree of BS in aeronautical engineering at the University of Washington, Seattle, Wash., in 1938.

EDW. S. CHRISTIANSEN Co. has established a showroom, technical library, and office pertaining to aluminum and magnesium at 831 S. Flower St., Los Angeles 14, Calif. The exhibits will include aluminum and magnesium raw materials, semi- and fully-fabricated castings and wrought parts, as well as finished assemblies representing the products and developments of leading aluminum and magnesium producers, fabricators, foundries, and research organizations. The displays will be changed from time to time to show the trend of conversion from war manufacture to civilian applications.

ALLIED APPLIANCE AND PLASTIC Co. is the new name adopted for the ALLIED APPLIANCE Co., 1014 N. La Brea Ave., Los Angeles 38, Calif. R. B. GUTSCH is owner and manager of the firm.

ROY CRAWSHAW has been advanced from the position of manager of plants in the Los Angeles district for the Western Gear Works, Seattle, Wash., to manager of engineering and sales for the company, with headquarters in Seattle. W. A. WITHAM has been appointed assistant manager of engineering. P. L. BANNAN, treasurer of the company, has been made manager of manufacturing for all plants, with G. A. DEARMAND as assistant.

District of Columbia, Maryland, and Georgia

GEORGE S. GARRARD has been made chief engineer of the Briggs Clarifier Co., Washington, D. C. Mr. Garrard was formerly assistant chief engineer with the Jacobs Aircraft Engine Co., Pottstown, Pa., and at an earlier period, was with the Pratt & Whitney Aircraft Corporation, East Hartford, Conn. A. M. ANDREWS has joined the staff of the company as one of the chief service engineers for the Aviation Division. He will be mainly concerned with commercial airline service. Mr. Andrews is a veteran pilot in the Air Service. Before his discharge as a captain in 1944, he had to his credit five Atlantic crossings and eighty-four missions "Over the Hump" while in the China-Burma-India service.

GLENN L. MARTIN, president of the Glenn L. Martin Co., Baltimore, Md., has been presented with the honorary degree of Doctor of Science by the University of Omaha in recognition of "his outstanding achievement in the application of scientific research, his international reputation in aeronautical engineering, and his public services to this country and the world at large." Recently Mr. Martin was honored with the degree of Doctor of Engineering by the Case School of Applied Science, Cleveland, Ohio.

C. W. MOORE and C. T. O'CONNELL have been appointed sales and service representatives by the Eclipse Counterbore Co., Detroit, Mich., in the Atlanta, Ga., territory, which covers the states of Alabama, Georgia, Florida, Tennessee, and North and South Carolina.

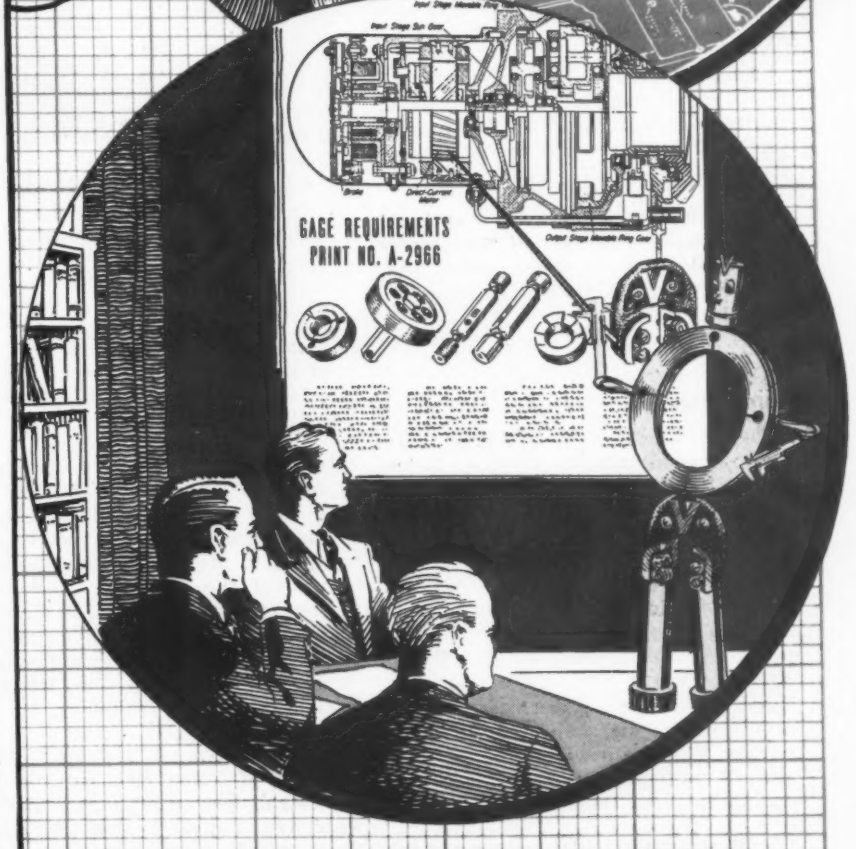
Illinois and Indiana

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill., warehouse steel distributors, announce the election of WILLIAM SEYMOUR, JR., as assistant vice-president and MERLE A. MILLER as assistant treasurer. Mr. Seymour is a graduate of the Sheffield Scientific School, Yale University. He has been with the Ryerson organization for twenty-eight years. Mr. Miller is a graduate of the School of Commerce, Northwestern University. He has been with the Ryerson organization for twenty-three years.

ELMER A. TERWELL has been appointed assistant manager of the Chicago plant of Salkover Metal Processing, an electric furnace copper brazing firm with plants in Long Island City, N. Y., and Chicago, Ill.

Roy Crawshaw, Recently Appointed Manager of Engineering and Sales for the Western Gear Works

GAGE ENGINEERING SERVICE



TO TAKE A LOAD OFF YOUR SHOULDERS... Your gaging problem + VARD gage engineering = quality control of your product.

Gage Engineering is a Quality Control consultation service which you will purchase just as you employ other expert counsel.

VARD INC. is preparing to furnish complete Gage Engineering service, available to manufacturers in the United States and Canada. Highly trained Production and Gage Engineers will make a minute examination of your requirements, specifications, production drawings and processes. On the basis of the quality required, a careful decision will be furnished concerning limits of fits, sizes and accuracy of all threads, bores and shafts. A clear-cut specification of gages and gaging will be provided for every step in the manufacture and assembly of your finished product, with recommendations as to where you can procure it.

Without competent Gage Engineering you will sacrifice Quality Control, speed, uniformity and economy ☆ Start the ball rolling. Reach for your phone and call the nearest VARD representative. Let him tell you more about Gage Engineering.

VARD GAGE SERVICE ACROSS THE CONTINENT

BIRMINGHAM, ALABAMA	TOOL ENGINEERING SERVICE
LOS ANGELES, CALIFORNIA	MACHINISTS' TOOL & SUPPLY CO.
SAN FRANCISCO, CALIFORNIA	DOUGLAS & STURGESS
DENVER, COLORADO	JOHNSON SUPPLY COMPANY
BRIDGEPORT, CONNECTICUT	WARD-NAGEL TOOL SUPPLY CO., INC.
ATLANTA, GEORGIA	FULTON SUPPLY CO.
CHICAGO, ILLINOIS	ENGIS EQUIPMENT CO.
INDIANAPOLIS, INDIANA	DACO TOOL & ENGINEERING CO.
DES MOINES, IOWA	GLOBE MACHINERY & SUPPLY CO.
WICHITA, KANSAS	WHITE STAR MACHINERY & SUPPLY CO
NEW ORLEANS, LOUISIANA	MURRAY-BAKER-FREDERIC, INC.
DETROIT, MICHIGAN	B. A. TAYLOR COMPANY
MUSKEGON HEIGHTS, MICHIGAN	O. R. A. INDUSTRIAL SERVICE
MINNEAPOLIS, MINNESOTA	THE JOHN C. EIDE CO
KANSAS CITY, MISSOURI	FRED A. ELLFELDT CO
ST. LOUIS, MISSOURI	MILL SUPPLY & MACHINERY CO
NEW YORK, N. Y.	WALTER D. BRIGGS CO
ROCHESTER, NEW YORK	THE SIDNEY B. ROBY CO.
SYRACUSE, NEW YORK	SYRACUSE SUPPLY COMPANY
CINCINNATI, OHIO	THE BINGHAM TOOL & SUPPLY CO
CLEVELAND, OHIO	MARK E. MOFFETT
TOLEDO, OHIO	KLATT & WOOD MACHINERY
OKLAHOMA CITY, OKLAHOMA	HART INDUSTRIAL SUPPLY CO
TULSA, OKLAHOMA	HART INDUSTRIAL SUPPLY CO
PORTLAND, OREGON	THE GENERAL TOOL CO.
BALA-CYNWYD (PHILA.), PENNSYLVANIA	CARLIN & COMPANY
PITTSBURGH, PENNSYLVANIA	A. D. "BERT" SUTHERLAND
YANKTON, SOUTH DAKOTA	DAKOTA SUPPLY CO
MEMPHIS, TENNESSEE	HAYS MACHINE TOOL CO
DALLAS, TEXAS	TOOL SUPPLY & ENGINEERING CO.
HOUSTON, TEXAS	HUGE-FAYLE CO
SALT LAKE CITY, UTAH	INDUSTRIAL SUPPLY CO
SEATTLE, WASHINGTON	CAMPBELL HARDWARE & SUPPLY CO.
SPOKANE, WASHINGTON	W. R. MATTHEWS MACHINERY & TOOL SUPPLY CO
WASHINGTON, D. C.	E. W. WAECHTER COMPANY
MILWAUKEE, WISCONSIN	TRIPLEX SUPPLY CO
VANCOUVER, BRITISH COLUMBIA	HALL EQUIPMENT & PRODUCTS, LTD

VARD INC.
PASADENA 8, CALIF.

ARMY E NAVY

Mr. Terwell was connected for twenty years with the Chicago office of the Driver-Harris Co.

GOTHARD MFG. CO., Springfield, Ill., designer and manufacturer of pilot light assemblies for electronic and electrical equipment and appliances, has erected a new modern plant which will enable the company to materially enlarge its engineering and research departments, as well as its manufacturing facilities.

ROCKFORD CLUTCH DIVISION OF BORG-WARNER CORPORATION, Rockford, Ill., has opened new engineering laboratories. Machinery and testing equipment for clutches in eight distinct fields served by the Rockford Clutch Division is being installed, so that clutches for every purpose can be developed and tested.

JOHN W. LOHNES, formerly assistant general manager of sales, Vanadium Corporation of America, New York City, has been appointed district sales manager, Chicago District, succeeding the late Le Roy F. Johnson. Mr. Lohnes' headquarters will be at the corporation's offices in the Field Building, 135 S. La Salle St., Chicago, Ill.

JOHN A. CALLANAN has been made manager of the Electronic Division of the Illinois Tool Works, Chicago, Ill. He will direct the company's activities in the manufacture and marketing of high-frequency equipment for induction and dielectric heating.

JAMES C. PATTON, JR., has been placed in charge of the Chicago sales office of the Heppenstall Co. at 208 S. La Salle St. Mr. Patton formerly served as sales engineer in Detroit.

JOHN W. CRAIG has been appointed general works manager of the Crosley Corporation's plant at Richmond, Ind. Mr. Craig has been with the organization since 1937.

Michigan

ROY I. MACARTHUR, formerly assistant superintendent of the Buick Forge Plant, Flint, Mich., has been advanced to the position of superintendent of the plant, succeeding the late Robert H. Darnton. NOEL F. YOUNG, previously assistant superintendent in charge of the die shop, has been made assistant superintendent of the forge plant. WALTER G. MALMQUIST, formerly general foreman, has become assistant superintendent in charge of the die shop, and HENRY J. LANDIS, who has been serving as night general foreman, has been made general foreman of the die shop.

J. M. CRAWFORD, chief engineer of the Chevrolet Motor Division of General Motors, Detroit, Mich., since 1929, has been transferred to the central office engineering staff of the Chevrolet Division as assistant to C. L. MCCUEN, vice-president. Mr. Crawford, who has been in automotive engineering ever since he started as a draftsman with the American Motor Car Co. in 1906, is president of the Society of Automotive Engineers.

COLONIAL BUSHINGS, INC., maker of drill jig bushings, has moved into new quarters at 21601 Hoover Road, Detroit, Mich. At its new location, the company will have the facilities to carry an expanded line of standard drill bushings in stock, ready for immediate shipment.

ERIC W. PETERSON has been appointed chief engineer of the Kaydon Engineering Corporation, Muskegon, Mich.

Eric W. Peterson, Newly Appointed Chief Engineer of the Kaydon Engineering Corporation

For the last six years, he has been chief engineer of Ditto, Inc., Chicago, Ill. He graduated in 1924 from the Lowell Institute.

DR. HARRY WHITTAKER, crystallographer and diamond expert, has been made head of the research department of the Koebel Diamond Tool Co., Detroit, Mich. He will continue research begun for the National Academy of Science on grading industrial diamonds according to their crystal structure. Dr. Whittaker formerly was instructor of crystallography at the Massachusetts Institute of Technology.

GENESEE TOOL CO., Fenton, Mich., producer of Tomahawk cutting tools, has established an office at 8855 Woodward Ave., Detroit 2, Mich., with E. W. KECK, service and sales engineer, in charge.

Underwood & Underwood

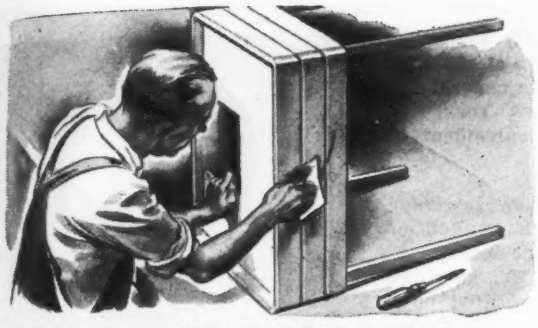
Paul Mueller, Manager of Engineering and Research, Pratt & Whitney

New England

PAUL MUELLER, formerly chief engineer of the Blaw-Knox Co., has become manager of engineering and research of the Pratt & Whitney Division, Niles-Bement-Pond Co., West Hartford, Conn. Mr. Mueller had previously been with the Pratt & Whitney organization from 1920 to 1927. Later, he was superintendent of the Hartford Machine Screw Co., and has also been with the General Cable Corporation and the Revere Copper and Brass Co.

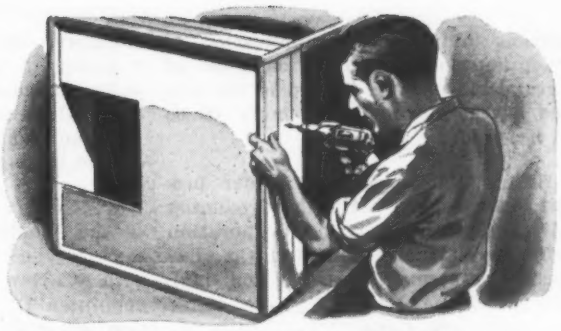
IVAN A. SWIDLO, chief engineer of the Springfield Armory, Springfield, Mass., was recently awarded a citation and emblem by the Secretary of War "in recognition of his outstanding engineering achievements in the devel-

Ivan A. Swidlo, Who Recently Received a Citation from the Secretary of War



SHUTS OUT SLIP-UPS!

Assembling baby furniture was mighty slow work with slotted screws, one manufacturer found. Too many scratches to refinish – scratches caused by driver skids. So to pick up production he switched to Phillips Screws . . .



FRIENDLY TO PROFITS!

. . . out went burred heads and driver skids and slant driven screws. Out went slow-as-molasses hand driving. In came power driving – and with it, savings in time and materials that sliced a big chunk off assembly costs.

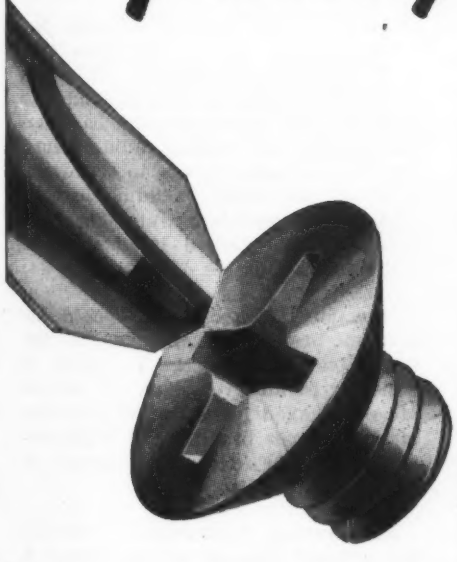
LONG ON SAFETY!

By making it stronger and more rigid, and by banishing dangerous burrs, Phillips Screws made this furniture safer for the kids. And your designers will find they do the same things for your product – whether it's tiny as a hearing aid or hefty as a harvester!

TOUGH ON COMPETITION!

Because of the ornamental design of the recess, Phillips Recessed Head Screws impart a "quality look" to any product. They give you a burr-free, blemish-free job that tells prospects you're on *your* toes – and warns competitors to watch out for *theirs!*

It's Phillips — the engineered recess!



In the Phillips Recess, mechanical principles are so correctly applied that every angle, plane, and dimension contributes fully to screw-driving efficiency.

. . . It's the exact pitch of the angles that eliminates driver skids.

. . . It's the engineered design of the 16 planes that makes it easy to apply full turning power – without reaming.

. . . It's the "just-right" depth of recess that enables Phillips Screw Heads to take heaviest driving pressures.

With such precise engineering, is it any wonder that Phillips Screws speed driving as much as 50% – cut costs correspondingly?

To give workers a chance to do their best, give them faster, easier-driving Phillips Recessed Head Screws. Plan Phillips Screws into your product now.

PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS

Made in all sizes, types and head styles

25 SOURCES

American Screw Co., Providence, R. I.
Atlantic Screw Works, Hartford, Conn.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
General Screw Mfg. Co., Chicago, Ill.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
Manufacturers Screw Products, Chicago, Ill.
Milford Rivet and Machine Co., Milford, Conn.
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
The Steel Company of Canada Ltd., Hamilton, Canada
Wolverine Bolt Co., Detroit, Mich.

opment and practical application of machine tools for the production of Garand rifles." Mr. Swidlo is the first one at the Springfield Armory to be so honored.

BYROM JUDSON SMITH, former production executive with the Lycoming Division of the Aviation Corporation and the Marmon-Herrington Co., has been appointed chief production engineer of Pitney-Bowes Postage Meter Co., Stamford, Conn.

POULSEN & NARDON, INC., Los Angeles, Calif.—a stamping and die plant—has been purchased by SOLOMON EISENROD, president of the Lincoln Machine Co., Inc., Pawtucket, R. I. Solomon Eisenrod and his brother, HARRY E. EISENROD, will head the company as president and vice-president, respectively. C. J. NARDON will remain with the company as general manager.

New Jersey

KENNETH MACGRATH, executive vice-president of Air Associates, Inc., Teterboro, N. J., has been elected president of the corporation, effective August 1, succeeding HAROLD I. CROW, who has resigned. Before being connected with Air Associates, Mr. MacGrath was associated with the Bendix Aviation Corporation as general manager of the Eclipse-Pioneer Division. Prior to that, he was with the Westinghouse Electric Corporation and the Monroe Calculating Machine Co.

CLYDE C. BOHNER has been made vice-president of the Lawrance Aeronautical Corporation, Linden, N. J. Mr. Bohner was formerly an executive of the Western Cartridge Co. and a vice-president in charge of sales of the Tungsol Lamp Works, Newark, N. J.

AEROIL PRODUCTS CO. is the new name of the organization formerly known as AEROIL BURNER CO., West New York, N. J., manufacturer of oil-fired, gas-fired, and electrically heated industrial equipment.

New York

VICTOR R. WILLOUGHBY, vice-president formerly in charge of engineering and latterly director of research and development for the American Car & Foundry Co., New York 8, N. Y., is retiring after an association of almost fifty years with the company. Shortly after graduation from the University of Michigan, class of 1896, with the degree of B.S.M.E., Mr. Willoughby went to work for the Michigan Peninsular Car Co. When that company was taken over by the American Car & Foundry Co. at the time of its incorporation in 1899, he was appointed assistant mechanical engineer. He subsequently served as engineer at various plants of the company, ultimately becoming general mechanical engineer at New York. In 1938, he was elected vice-president in charge of engineering.

W. SPRAGUE, executive secretary of the Welding Research Council of the Engineering Foundation, 29 W. 39th St., New York 18, N. Y., has been appointed to the newly created position of director. The Welding Research Council is a cooperative scientific research organization, sponsored by the American Welding Society and the American Institute of Electrical Engineers and working in close cooperation with all the national engineering societies.

ZIMMER-THOMSON CORPORATION, 29-05 Review Ave., Long Island City, N. Y., manufacturer of constant-speed propellers, "Thriftmaster" multiple-spindle drill heads, and ball bushing reciprocating bearings, announces that the name of the concern has been changed to THOMSON INDUSTRIES, INC.

Dr. C. R. AUSTIN, professor of metallurgy at Pennsylvania State College, has been appointed assistant to the president of the Meehanite Metal Corporation, Pershing Square Bldg., New Rochelle, N. Y.

FRANK M. HAWLEY has been appointed vice-president and general manager and has been elected to the board of directors of the Morse Chain Co., Ithaca, N. Y. Mr. Hawley was formerly manager of the company's Detroit plant. He has been associated with the Morse Chain Co. since 1919. He succeeds C. J. KENERSON, who retires as active head but continues as a director and vice-president.

Frank M. Hawley, New Vice-President and General Manager, Morse Chain Co.

Paul W. Bernhard, New Advertising Manager of the Morse Chain Co.

PAUL W. BERNHARD has been made advertising manager of the Morse Chain Co., Ithaca, N. Y. He was formerly with the Bell Aircraft and the Curtiss-Wright organizations at Buffalo, N. Y.

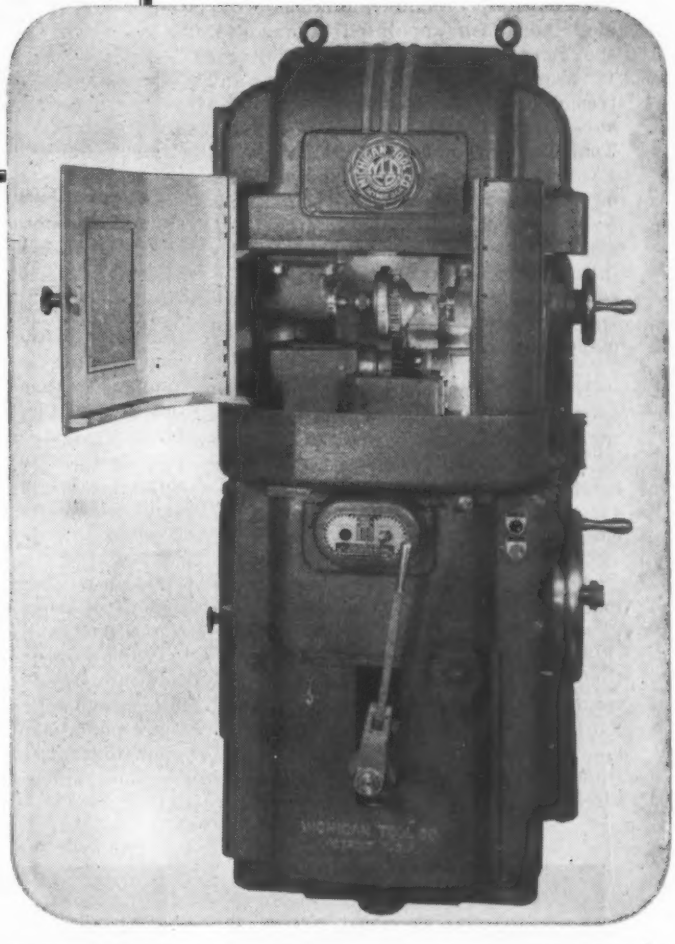
GENERAL ELECTRIC CO., Schenectady, N. Y., is planning to build a new research laboratory that will afford some 50 per cent more space than provided by the present facilities and will cost in the neighborhood of $8,000,000. The site of this research laboratory is a private estate known as "The Knolls," covering 219 acres about 4 1/2 miles from the main plant in Schenectady, overlooking the Mohawk River.

OMEGA MFG. CO., 187 Cottage St., Poughkeepsie, N. Y., announces that it is installing equipment for manufacturing a complete line of unground ball bearings and unground ball-bearing rollers for radial, radial thrust, and thrust loads, for use in conveyors, washing machines, vacuum cleaners, agricultural machinery, etc. The bearings will be supplied in sizes up to 2 1/4 inches outside diameter.

HOWARD D. FLICKER has been appointed production manager of the Long Island City, N. Y., plant of Salkover Metal Processing, an organization engaged in commercial electric furnace copper brazing and bright annealing. Mr. Flicker is a graduate of Rutgers University.

M. HERBERT EISENHART, president and general manager of the Bausch & Lomb Optical Co., Rochester, N. Y., has been elected chairman of the board of trustees of the University of Rochester. Mr. Eisenhart has served continuously as a trustee of the university since 1926.

cut
GEAR SHAVING TIME
in half



WITH "UNDERPASS" SHAVING

Michigan Rotary "Underpass" type gear finishers—a GEAR PRODUCTION HEADQUARTERS development—are already doing just that. They eliminate the necessity for both cutter infeed and transverse cutter or work reciprocation. One pass of the cutter, usually, and the gear is finished. Furthermore, underpass finishing can be used with ease on close-shoulder gears.

Completely automatic in operation. Virtually eliminates the human element in obtaining the highest of precision at low cost. For further information just ask for

"Data on
Underpass Shaving"

OTHER GEAR PRODUCTION HEADQUARTERS PRODUCTS INCLUDE

Rack type gear finishers for highest precision and lowest cost per piece in mass production

Rotary Gear Finishers for gears from ¼ inch to many feet in diameter

SHEAR-SPEED gear shapers which will cut a gear as fast as you can shave it

Gear Lappers; SINE-LINE gear and gear tool checking equipment; all types of spur and helical gear cutting tools.

ORIGINATORS of GEAR SHAVING

MICHIGAN TOOL COMPANY

7171 E. McNICHOLS ROAD **DETROIT 12, U. S. A.**

BUY U.S. BONDS STAMPS

FRANK C. HASSE has been elected vice-president of the mechanical department of the Oxweld Railroad Service Co., a unit of Union Carbide and Carbon Corporation, New York 17, N. Y.

Ohio

CLEVELAND PNEUMATIC TOOL CO., 3781 E. 77th St., Cleveland 5, Ohio, announces the following promotions: ELMER J. STEGER, manager of the Pneumatic Tool and Appliances Division, has been appointed manager of the Rock Drill Division. Mr. Steger is also executive vice-president and treasurer of the company's Canadian subsidiary, the Cleveland Pneumatic Tool Co. of Canada, Ltd. CHARLES E. VANDERPOOL, former assistant manager of the Pneumatic Tool Division, has been made sales manager of that division. ALBERT H. HRUBY, until recently in charge of contract termination, becomes sales manager of the Rock Drill Division. ROBERT CRAIG has been made manager of export sales.

HARRY D. WAGNER has been added to the staff of engineers who are serving the Cleveland area for the Foxboro Co., Foxboro, Mass. He will have headquarters at the company's office, 417 Bulkley Bldg., 1501 Euclid Ave., Cleveland 15, Ohio.

ARMIN G. KESSLER has been made manager of sales of the Midwestern district with headquarters at Akron, Ohio, for the Farrel-Birmingham Co., Inc., Ansonia, Conn. Mr. Kessler has been with the Farrel-Birmingham organization since 1920, when he became general manager of the company's Buffalo, N. Y., plant. He has been a vice-president and director since 1923, and prior to the present appointment, was general works manager of the company's three plants in Ansonia and Derby, Conn., and Buffalo, N. Y.

Armin G. Kessler, Midwestern Manager of Sales for Farrel-Birmingham Co.

JOSEPH WAINWRIGHT has been appointed sales manager of the Boyé & Emmes Machine Tool Co., Cincinnati 15, Ohio.

FRANK M. ALDRIDGE has been made general sales manager of the Ohio Tool Co., N.B.C. Bldg., Cleveland 14, Ohio. Previous to becoming connected with the Ohio Tool Co., Mr. Aldridge was associated with the War Production Board as a deputy regional director. Prior to that, he was executive vice-president and secretary of the Roach-Reid Co.

Frank M. Aldridge, General Sales Manager for the Ohio Tool Co.

Lonnis Denison, Vice-president and Assistant General Manager, Denison Engineering Co.

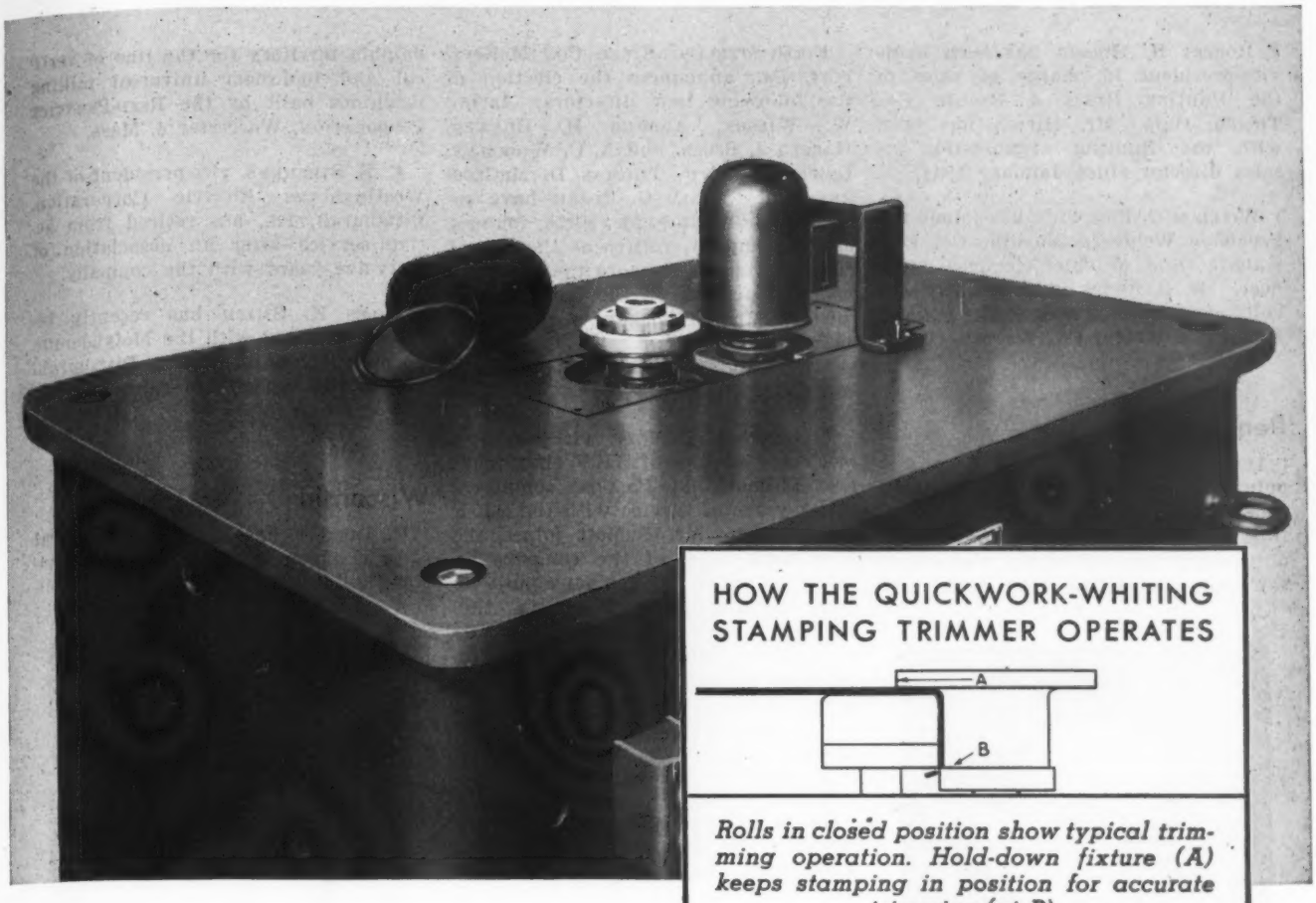
Frank C. Norris, Vice-president in Charge of Manufacturing for Denison Engineering Co.

LONNIS DENISON, formerly assistant general manager of the Denison Engineering Co., Columbus, Ohio, has been appointed vice-president and assistant general manager of the company, and FRANK C. NORRIS, previously director of production, has been made vice-president in charge of manufacturing and engineering. Mr. Denison has been active in the company's management since 1942, and Mr. Norris has been associated with the organization since it first started in business in Delaware, Ohio.

BRUSH DEVELOPMENT CO., Cleveland, Ohio, announces the appointment of the following new sales representatives: BURLINGAME ASSOCIATES, LTD., New York City, for the eastern New York and northern New Jersey area; MORRIS F. TAYLOR CO., Silver Spring, Md., for the central Atlantic, southeastern and southern states; TERWILLIGER SALES CO., Kansas City, Mo., for Iowa, Kansas, Nebraska, and Missouri; DAVID M. LEE CO., Seattle, for Washington, Oregon, and Idaho.

CARPENTER STEEL CO., Reading, Pa., announces the opening of a new Cincinnati, Ohio, warehouse located at 5137 Vine St., St. Bernard. Until a few months ago the products of the company were distributed in this territory by the Frederick Steel Co. The new warehouse will be under the direction of the southwestern manager, K. L. CRICKMAN, and will also be headquarters for district representatives CHARLES V. LUIN and JOHN A. KOCH.

J. H. GULICK, formerly director of purchases for Lempco Products, Inc., Bedford, Ohio, has been promoted to the position of general factory manager, and will have supervision over production in all six Lempco plants.



HOW THE QUICKWORK-WHITING STAMPING TRIMMER OPERATES

Rolls in closed position show typical trimming operation. Hold-down fixture (A) keeps stamping in position for accurate trimming (at B).

The FAST, ACCURATE way to trim and form complicated stainless, dural, or other alloy STAMPINGS

QUICKWORK STAMPING TRIMMER TRIMS • BEADS • FLANGES

Operating at cutting speeds of up to 30 feet per minute and trimming accurately to thousandths of an inch, the Quickwork Stamping Trimmer handles almost any stamping in a single plane. Cutting stainless, dural, and other alloys with ease, it trims, forms, beads, and flanges large or small stampings with or without flash.

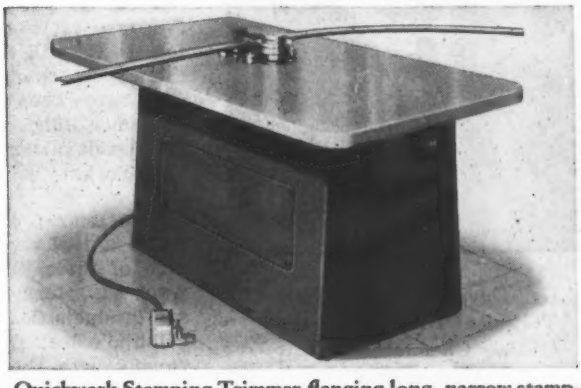
With the Quickwork, the need for expensive trimming dies is eliminated and valuable press time is saved. Special rolls, jigs, and fixtures adapt the Quickwork to the needs of the particular job, and both standard and heavy duty models are available.

Write for Bulletin QW-119.

QUICKWORK-WHITING DIVISION

WHITING CORPORATION

15673 LATHROP AVENUE, HARVEY, ILLINOIS



Quickwork Stamping Trimmer flanging long, narrow stamping. Standard models have pneumatic foot pedal control.

Hand lever operated machine used for special applications.

ROBERT R. HIRSCH has been made vice-president in charge of sales of the Bunting Brass & Bronze Co., Toledo, Ohio. Mr. Hirsch has been with the Bunting organization as sales director since January 1944.

WILLIAM G. BOSTWICK has joined the Precision Welder & Machine Co., Cincinnati, Ohio, as chief electrical engineer. Mr. Bostwick until recently was chief electrical engineer of the Federal Machine & Welder Co., Warren, Ohio.

Pennsylvania

DR. DAVID M. GANS has been appointed technical director of the Quaker Chemical Products Corporation, Conshohocken, Pa., manufacturer of chemical specialties for the metalworking and textile processing and

Dr. David M. Gans, New Technical Director of the Quaker Chemical Products Corporation

finishing industries. His duties will include the supervision of the Research, Service, and Control Laboratories of the corporation.

CHARLES A. SCARLOTT, editor of the *Westinghouse Engineer*, the science and engineering publication of the Westinghouse Electric Corporation, Pittsburgh, Pa., has been awarded the Order of Merit—the highest recognition for achievement given by the Westinghouse organization — for "his unusual skill, as an editor and writer, in making technical articles interesting and understandable." Mr. Scarlott is a graduate of the University of Arizona, class of 1925. He became connected with Westinghouse in 1926.

FIRTH-STERLING STEEL CO., McKeesport, Pa., announces the election of the following new directors: IRVING W. WILSON, ARTHUR H. BUNKER, HAROLD J. SZOLD, and A. C. WICKMAN. LEWIS J. FIRTH, THOMAS D. MCCLOSKEY, and DONALD G. CLARK have resigned as directors. Mr. Firth, founder of the company, retires at the age of eighty-seven, after more than seventy years of activity in the tool steel industry. Mr. McCloskey will continue as legal counsel, and Mr. Clark will continue to act in an executive and consulting capacity.

RICHARD H. DEMOTT, vice-president in charge of sales of S K F Industries, Inc., Philadelphia, Pa., has completed thirty years of service with the S K F organization. Mr. DeMott joined the New York office of the company in 1915; and when the company built its first manufacturing plant in this country in Hartford, Conn., he was made New York sales manager. Promotions quickly followed as district sales manager, manager of industrial development, assistant sales manager, general sales manager, and finally vice-president.

JESSOP EXPORT SALES CORPORATION, a subsidiary of the JESSOP STEEL CO., Washington, Pa., has been incorporated under the laws of Delaware to handle the export sales of the company and to act as an import agent. ROBERT A. PARKS, for several years Jessop's representative in Washington, D. C., will be general manager of the export company. Temporary offices have been established in the Bessemer Bldg., Pittsburgh, Pa. Later the headquarters will be moved to New York.

KENNAMETAL, INC., Latrobe, Pa., has added a tool engineer to the staff of each of three district offices. ALFRED ANDERSON, formerly with the Linde Air Products Co., has joined the Philadelphia office; GILBERT A. BUNN, previously with the Pontiac Motor Division of General Motors, has become connected with the Detroit office; and JACK WRIGHT, formerly with the Brown & Sharpe Mfg. Co. and the Bendix Aviation Eclipse-Pioneer Division, has joined the West Hartford, Conn., office.

FREDERICK W. ROHDE has been made manager of quality control at the Westinghouse Electric Corporation's Aviation Gas Turbine Division at South Philadelphia, Pa. Mr. Rhode was formerly chief inspector at the Jacobs Aircraft Engine Co. He was the first American to attempt a transatlantic flight from Europe to America in 1927.

CALCO MACHINERY CO., 1420 Chestnut St., Philadelphia 2, Pa., has been appointed exclusive agent in the Philadelphia territory for the line of vertical and tool-room universal milling machines built by the REED-PRENTICE CORPORATION, Worcester 4, Mass.

C. E. STEPHENS, vice-president of the Westinghouse Electric Corporation, Pittsburgh, Pa., has retired from active service after an association of forty-five years with the company.

MILES K. SMITH has recently become associated with the Molybdenum Corporation of America, Pittsburgh, Pa., in the capacity of sales and service engineer.

Wisconsin

F. DUGGAN has been made general sales manager of the Deepfreeze Division, Motor Products Corporation, Mil-

F. Duggan, General Sales Manager of the Deepfreeze Division of Motor Products Corporation

waukee, Wis. He will direct the sales of both Deepfreeze industrial chilling equipment and home freezers. Mr. Duggan was formerly an active partner in the C & D Distributing Co., Charleston, S. C.

J. C. SCHAEFER, field engineer of Allis-Chalmers Mfg. Co.'s Pittsburgh district office, has been appointed branch office manager at Youngstown, Ohio, succeeding E. H. LEGLER, who has been transferred to the electrical department at Milwaukee, Wis. L. E. STACEY, also field engineer of the Pittsburgh district office, has been transferred to Wheeling, W. Va., in which locality he will serve as resident field engineer.

Heavier DRAWS . . . *Less* SCRAP . . . *Longer* DIE LIFE!

IF QUAKER research chemists and engineers had been content to employ only *conventional* types of raw materials in developing drawing compounds, the metal industries would not now be enjoying the superior performance of modern QUAKER DRAWS.

For example, the newest QUAKER DRAW —#140—contains a *new type pigment.* This so effectively cushions and lubricates the die that heavier-than-ever work can be handled . . . with far less scrap . . . with much longer die life.

Mixed with from 2 to 8 parts water, QUAKER DRAW #140 makes an excellent all-purpose die lubricant that is easy to mix and pleasant to handle . . . provides very effective protection against rust when left on drawn parts . . . and can be removed in an alkaline bath, even after long storage.

Another Quaker development, especially advantageous in forming parts to be porcelain enameled, is QUAKER DRAW #4-60. This compound completely *burns off* when drawn parts are welded and greatly reduces the amount of metal finishing required. Other new Quaker compounds give exceptional results on *stainless steel* and *aluminum.*

QUAKER DRAWS are now helping plane and armament manufacturers set new records in production . . . in die life . . . and in reduction of scrap. Tomorrow, these same manufacturing economies can help your peacetime products meet and beat competition!

A Quaker Process Engineer will gladly work with you now to obtain the maximum advantages which these new compounds make possible!

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A Progressive Organization of Research and Process Engineers and Manufacturing Chemists

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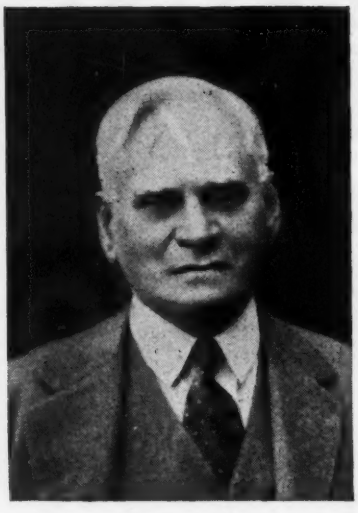
Obituaries



E. R. Fellows

E. R. Fellows, founder and president of the Fellows Gear Shaper Co., Springfield, Vt., died suddenly at his home in that city on May 21 at the age of eighty years. He was born in Torrington, Conn., in 1865.

Mr. Fellows organized the Fellows Gear Shaper Co. in the fall of 1896—nearly fifty years ago—to build machines developed on the basic patents granted him on a gear-cutting machine and cutter. The first machine and cutter were ready for the market in the spring of 1897, and at that time a machine for grinding gear-shaper cutters was also designed and built. In 1899, he received the John Scott Medal "for a machine and cutter for generating gear teeth," on the recommendation of the Franklin Institute, Philadelphia, Pa.

In his lifetime, Mr. Fellows was granted some thirty-five patents covering gear-manufacturing equipment. It is difficult today to realize what a radical change in the making of gears his original patents brought about, for when the gear shaper was first developed, the art of gear-cutting was not highly advanced, and the gear shaper represented an outstanding step forward in that art. It has been stated by men well versed in gear-cutting developments that at the time when he worked out the first practical machine employing the molding-generating principle for the forming of spur-gear teeth, he was the first man in the United States to fully appreciate the broad possibilities of that principle in spur-gear production.

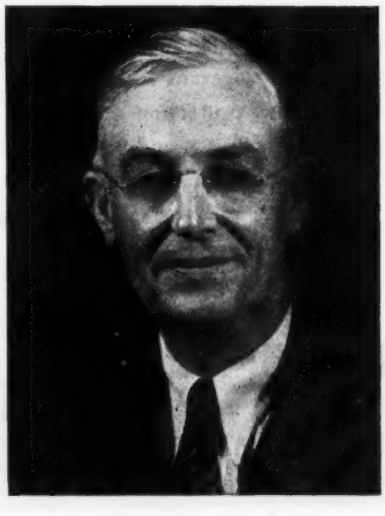
The gear shaper was developed about the same time as the automobile, and played an important part in the progress of that industry, as it became a means for cutting accurate gears on a production basis. Similarly in the aircraft industry, especially in its most recent developments, the gear-shaper method has played an important part in the production of accurate gears and in the making of other aircraft engine parts. Strangely enough, in the present war effort, this method has been used in a large measure to produce parts that are not gears, like Bofors gun parts and other artillery parts; rod ends for airplanes; tank, gun-turret, instrument, and camera parts, etc.

Mr. Fellows lived to see a small shop at first employing only seven men develop during his lifetime into one of the largest plants in the world for the manufacture of machines for producing gears. He was an outstanding pioneer in his line of endeavor, an inventive genius, and a remarkable organizer. He had the faculty of drawing capable men into his organization and of holding them. There are today 110 men in the company that he founded who have been employed continuously for a quarter of a century or more—a truly remarkable record of loyalty to the man and organization he created.

Mr. Fellows is survived by his wife, the former Katherine Miller, and by a brother Herbert C., a son Russell M., two grandsons, Edwin R. and William H., and two great-grandchildren, all residing in Springfield, Vt.

Robert H. Darnton

Robert H. Darnton, for the last fifteen years superintendent of the Buick Forge Plant at Flint, Mich., died at his home in that city on May 27 following an illness of several weeks. He was sixty-two years old. Mr. Darnton contributed greatly to the technical progress in the forging industry. During the last four years of high-volume production, the forging practices that he and his associates introduced helped to make possible the high production rates of war equipment. Mr. Darnton became connected with the Buick organization in 1912 as a die-sinker in the forge plant. He was made general foreman of the die shop in 1918, forge superintendent in 1921, and was advanced to superintendent of the forge plant in 1932, which position he held until his death.



Robert H. Darnton

Thomas M. Skove

Thomas M. Skove, a director and general superintendent of the Cleveland Twist Drill Co., Cleveland, Ohio, was killed in action in Germany on May 4. He was overseas on a special assignment for the United States Strategic Bombing Survey.

Mr. Skove was forty-five years old. He was a graduate of Case School of Applied Science and a member of the American Society for Metals; the Electrochemical Society; and Sigma Xi, honorary scientific society. He had been elected president of the Cleveland Engineering Society after his departure for Europe. He was a life-long resident of Cleveland.

C. S. Morey, who had been associated with the Machine and Small Tool Divisions of the Barber-Colman Co., Rockford, Ill., since 1906, died on May 21. At the time of his death, he was in charge of the Barber-Colman office at 422 Mutual Bldg., Lansing, Mich. Mr. Morey was well known as an expert and consultant on hobbing and milling problems. During 1943 and 1944, he served as a field engineer for the Tools Division of the War Production Board, assisting on cutting tool production problems. His passing will be felt by the many friends whom he made in the course of his work.

C. Walter Spalding, manager of the Power Transmission Machinery Division of the Link-Belt Co., died suddenly on May 25 in Chicago, Ill. Mr. Spalding's headquarters were at the company's Ewart plant in Indianapolis. He became connected with the Link-Belt organization at Indianapolis in 1910. He is survived by his wife, a son—now lieutenant in the Army Air Corps—and a daughter.

* * *

Welding Safety Gloves

A safety glove made from high-grade chrome-tanned cowhide has been placed on the market by the American Optical Co., Southbridge, Mass. The new glove is intended particularly for use in performing welding operations, but it can also be worn for protecting the hands while doing other heavy-duty work. The principal feature of this glove is its one-piece back construction, there being no seams on the back to catch sparks or molten metal.

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SOLUBLE METAL WORKING OIL

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Shell Lubrication Engineers were consulted. The result was new Shell Virgo Oil. A soluble, metal working oil entirely new. A lubricant that can be removed with warm water, leaving the metal surface clean enough to paint . . . one that combines excellent lubricating properties with high cooling efficiency, is non-corrosive, gives good rust protection with high wetting characteristics that makes it extremely economical to use.

Since their introduction scores of performance records have been broken by versatile, new Shell Virgo Oil. For full details on this sensational line of oils, write: Shell Oil Company, Incorporated, 50 W. 50 St., New York 20, N. Y. Or 100 Bush St., San Francisco 6, California.

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New Books and Publications

TESTING MACHINE TOOLS. By Dr. Georg Schlesinger. 94 pages, 8½ by 11 inches; profusely illustrated. Published by the Machinery Publishing Co., Ltd., London, England. Sold in the United States by THE INDUSTRIAL PRESS, 148 Lafayette St., New York 13, N. Y. Price, $4.

The first English edition of this book was published in 1932 in response to the request of many machine tool manufacturers and users in Great Britain and the United States. The book was intended to provide a guide for the machine tool builder in assembling, testing, and inspecting his machines, and to provide the machine tool user with a standard of accuracy governing the acceptance of machine tools. The demand for the book affords ample evidence that it fulfilled the purposes for which it was designed.

The present is the fourth edition of this work. In the publication of this edition, several chapters have been amplified. Every effort has been made to give the specifications in such form that there is no possibility of misunderstandings arising through differences of interpretation by the buyer and the seller. The book is so subdivided that any desired section can be readily found, and the system of tolerances given in the charts has been maintained in a uniform manner throughout the whole series. As in the first edition, the metric system is used in the charts, but numerous conversion tables enable the inch equivalents of tolerances and other dimensions to be readily obtained. The new chapters included cover power and efficiency, control of speeds, and surface quality.

INDUSTRIAL ORGANIZATION AND MANAGEMENT. By L. L. Bethel, F. S. Atwater, G. H. E. Smith, and H. A. Stackman, Jr. 798 pages, 6 by 9 inches; 169 charts and illustrations. Published by the McGraw-Hill Book Co., 330 W. 42nd St., New York 18, N. Y. Price, $4.50.

This book is divided into two main sections—the organization of an industrial enterprise and the operation of the enterprise. Under the heading of organization, it deals with industrial risks and forecasting; financing; building and internal organization; research, engineering, and standardization in developing a product; and the organizing of the physical facilities. Under the heading of operation, it deals with manufacturing, administration, selling, and general management. There is also a section on coordination of an industrial enterprise.

The material for this book has been developed and used by the authors in connection with instruction work over a period of three years. It has grown out of the recognition of a need for a book that makes a balanced presentation. The authors make no claim to have originated principles new to industrial management; those treated in the book are in wide use by industry. They are thoroughly tried and tested and have been found to be sound.

ESTABLISHING AND OPERATING A METAL-WORKING SHOP. 202 pages, 6 by 9 inches. Published by the U. S. Department of Commerce, Washington, D. C. Available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Price, 35 cents.

This is Industrial Series No. 16 of the Department of Commerce, originally prepared as an educational manual for the War Department. It has been written especially to serve veterans, war workers, and employes in industrial enterprises who are seeking basic and authoritative advice relating to the starting of a business in the metal-working field. This book covers several kinds of small shops in this field. It is assumed that the reader is a thoroughly experienced skilled worker. Hence, the mechanical side of the business is not covered, except as it pertains to management.

Coming Events

OCTOBER 1-3 — Fall meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Cincinnati, Ohio. C. E. Davies, secretary, 29 W. 39th St., New York 18, N. Y.

NOVEMBER 26-30—Annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in New York City. C. E. Davies, secretary, 29 W. 39th St., New York 18, N. Y.

* * *

Knitted Wire Tubing

An interesting product known as "knitted" wire tubing is being manufactured by E. H. Titchener & Co., Binghamton, N. Y. This is a new industrial product with numerous applications. This tubing is actually knitted from a single wire formed of interlaced loops that form a seamless tube. It may be used as protective armor for hose, ducts, cables, etc., as a protective covering for fragile glass tubes, and as a non-slip grip for handles.

How One Company Publicizes Its Facilities for Peacetime Contract Work

An effective booklet, presented in most attractive form, has been published by the York Safe & Lock Co., York, Pa., for the purpose of acquainting industry at large with the facilities of the company for handling peacetime contract work. The publication is entitled "Can You Utilize These Facilities in Your Post-War Production?" It briefly describes and illustrates the war equipment that has been built by the company, then lists the available machine tools and equipment, and finally shows comprehensive illustrations of the different departments in the plant. Next to a visit to the plant, nothing could give a more adequate idea of this organization and its facilities for production work than this publication.

* * *

Improved Platinum Thermo-Couple Assembly

Improved platinum thermo-couple assemblies used with two-hole silica blocks for glass tank crowns have been developed by the Brown Instrument Co., Philadelphia, Pa. The improvement will result in longer service life for the protecting tube assembly, and will facilitate the removal of the thermo-couple assembly for periodic inspection. The major improvement consists of replacing with heat-resisting stainless steel the secondary protecting tube, previously made of regular steel.

* * *

Industrial Progress of Western States

The Light Metals Committee of the Western States Council held a meeting in Seattle, Wash., June 21 to 23. The purpose of this meeting was to record facts leading to the establishment of a light-metals industry in the western states, owned and operated by private capital. The war has brought to the West a large number of high-capacity aluminum reduction plants, one aluminum sheet-rolling mill, and a magnesium reduction plant. Industrialists in the western states see in these plants the nucleus of a highly developed light-metals industry in that territory.

During the meeting, a number of addresses were made pertaining to the aluminum and magnesium industries, the outlook for industries in the West, markets for light-metal industrial products, and other topics pertaining to the general subject of industrial development in the western states.

Precision, smooth finish, uniformity are the prime qualities you insist on in cold drawn steel bars. Our metallurgical engineers will be glad to discuss your production problems with you

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